



Statement of Qualifications to Support Investigations at the Libby, Montana CERCLA Site


1085861 - R8 SDMS

Submitted to
Remedium Group, Inc.
6401 Poplar Avenue, Suite 301
Memphis, TN 38119

August 2008

Parametrix

ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

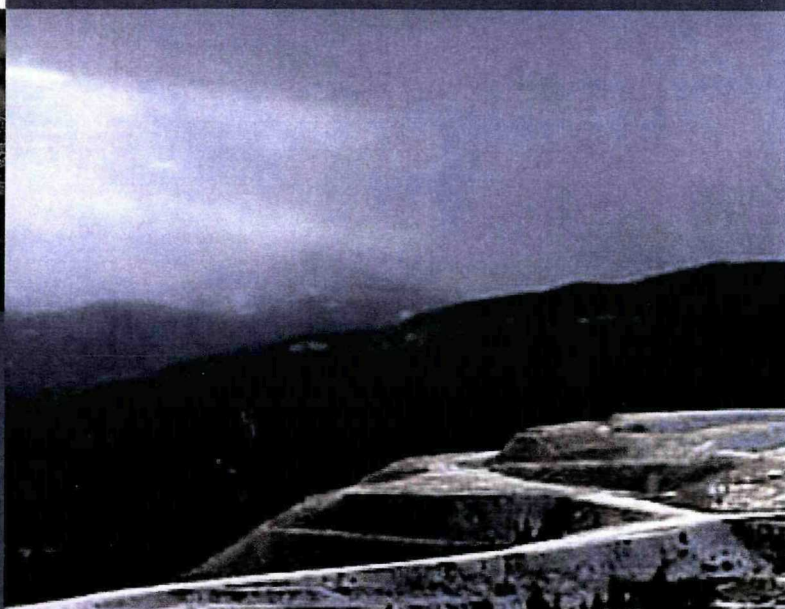


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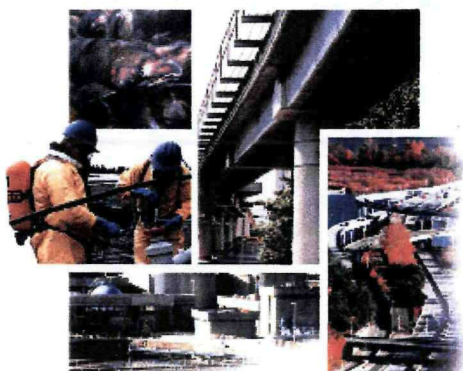


Parametrix

ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Introduction

Parametrix is a 100-percent, employee-owned firm dedicated to providing quality engineering, planning, and environmental sciences with superior client service. Founded in Washington in 1969, Parametrix has nine offices across the western United States and a staff of over 500 professionals providing multi-disciplinary services in transportation, natural resources, planning, water, wastewater, and environmental engineering and sciences.



An award-winning company, Parametrix is consistently listed in Engineering News Record's *Top 200 Environmental Engineering Firms* and *Top 500 Design Firms in the Nation*, was honored in the Environmental Business Journal Business Achievement Awards, and is ranked in CE News Magazine's *Top 50 Civil Engineering Firms to Work For in the Nation*. Additionally, Parametrix is consistently ranked by various state and regional entities as one of the top five firms in our region.

Parametrix guides clients through the decision-making processes required to achieve practical, cost-effective solutions for each project. We achieve this objective by maintaining a staff of some of the most talented engineers, scientists, and project managers in the business. The foundation of our success is quality staff; our employee-owners are committed to consistently providing products and services that reflect our clients' needs and expectations.

Parametrix Service Areas

- Site Investigations
- Natural Resource surveys
- Toxicology and Ecotoxicology
- Risk Assessments (human, ecological)
- Ecotoxicology Research and Laboratory Testing (Aquatic, Terrestrial)
- Mine Permitting and Environmental Impact Assessment
- Project Permitting and Planning
- Watershed Investigations
- GIS, Statistics, Database Development
- Land Survey
- Focused Site Investigations
- Remedial Investigation and Feasibility Studies (RI/FSs)
- Engineering Evaluation/Cost Analyses (EE/CAs)
- Evaluation of Treatment Technologies
- Remedial Design
- Development of Plans and Specifications
- Removal Oversight
- Pilot and Bench-Scale Testing
- NEPA/SEPA Compliance
- Revegetation Design and Planning
- Fisheries and Habitat Ecology
- Wetlands Evaluation and Mitigation
- Endangered Species Act (ESA) Compliance
- Aquatic and Marine Sciences
- River Engineering and Restoration
- Landscape Architecture and Urban Planning
- Stormwater and Watershed Management
- Water Quality Modeling and Monitoring
- Wastewater Treatment, Disposal and Conveyance
- Waste Reduction and Recycling Programs
- Construction Management
- Hydrological Assessments

Excellence is the foundation of our Toxicology and Risk Assessment Group at Parametrix. The Group includes toxicologists who are well known nationally and internationally for their work on chemical-specific toxicological and risk assessment issues for a number of high visibility projects. We also have an in-house research laboratory, the Parametrix Environmental Research Laboratory (PERL). With widely published expertise in aquatic and terrestrial ecotoxicology and toxicity testing, we are able to provide clients with a unique combination of practical support for a wide range of regulatory compliance needs and state-of-the-science research on focal issues. The Group includes significant depth of expertise in numerous technical areas including:

- Aquatic, terrestrial, and human health toxicology
- Risk assessment (ecological, human health)
- Laboratory specialized research and toxicity testing
- Design and conduct of multimedia field studies
- Regulatory compliance

This Statement of Qualifications (SOQ) presents information on our capabilities to support the Remedium Group in each of technical service areas, followed by an overview of the qualifications of our key staff. Full Curriculum Vitae are included in Appendix A.

Aquatic, Terrestrial, and Human Health Toxicology

Our toxicology-related services include scientific literature compilation and review, construction and maintenance of toxicity databases for a wide range of regulatory needs, derivation and modification of regulatory water quality, soil, and sediment criteria, and the design of special studies. PERL, located near Corvallis, Oregon, provides a flexible, state-of-the-art facility for conducting static and flow-through aquatic toxicity tests, sediment toxicity tests, and terrestrial toxicity tests to support toxicology, risk assessment, and other environmental research needs.

Review and Assessment of Ambient Water Quality Criteria for Cyanide

Client: Water Environment Research Foundation

Parametrix recently completed a scientific reevaluation of the current ambient water quality criteria (AWQC) for cyanide. Our work focused on evaluating *A Critical Review of Cyanide Toxicity Data*, which was published after the U.S. Environmental Protection Agency's (EPA) 1984 AWQC document for cyanide. New aquatic toxicity testing was conducted with freshwater and marine organisms (including rock crabs, copepods, threespine sticklebacks, and larval amphibians). New methods were validated for analytical chemistry of free cyanides. The results suggested that recalculated acute and chronic AWQC for freshwater organisms would be largely unchanged from the current 1984 guidance, but that acute AWQC for marine organisms could be five-fold higher than current guidance and still provide adequate levels of protection. Consistent with EPA's draft strategy for developing future AWQC, recalculated freshwater criteria also would likely protect aquatic-dependent wildlife, benthic organisms, and most freshwater threatened and endangered species.

Evaluation of the Toxicity of Nickel to Marine Organisms and Derivation of Probable No Effect Concentrations/Ambient Water Quality Criteria

Client: Nickel Producers Environmental Research Association

Parametrix led a project to identify and quantify the acute and chronic toxicity of nickel to a variety of aquatic marine organisms. Species tested included algae, invertebrates, and a range of fish species. The overall objective of this study was to generate a toxicological dataset that would be suitable for the derivation of Probable No Effect Concentrations (PNECs) in Europe using a Species Sensitivity Distribution (SSD), as well as AWQC in the United States.



Toxicity of Acid Waters to Avian Wildlife

Client: Confidential

Parametrix was retained to design and oversee the conduct of an acute drinking water toxicity study with aquatic-dependent wildlife. The objectives of this test were to determine effects of the client's industrial process waste pond water on body weight, feed consumption, water consumption, behavior, and survival of juvenile mallard ducks. Acidified pond water and/or regular drinking water were offered to non-dehydrated, dehydrated, and dehydrated and fasted birds. The test duration was 2 days (48 hours) of exposure to the specified drinking water types (exposure period), followed by 3 days (approximately 72 hours) of



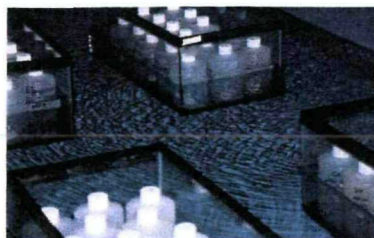
additional observation (post-exposure period) with all birds receiving clean drinking water (control water). Mortality and symptoms of sublethal intoxication were monitored by observations of each test animal every two hours, including the dark hours, during the 48-hour treatment period. Test birds were observed three times during light hours for the 3 days of post-treatment conditions. All mortalities and observations, normal

or otherwise, were recorded. All birds were then sacrificed and necropsies performed to determine what (if any) physiological effects were attributed to the treatment.

Evaluation of the Toxicity of Manganese to Aquatic Organisms and Derivation of Probable No Effect Concentrations/Ambient Water Quality Criteria

Client: Confidential

Parametrix designed and conducted laboratory tests to evaluate the toxicity of manganese to aquatic organisms and to provide data suitable for the derivation of PNECs/AWQC in the European Union, Canada, and the United States. In addition, Parametrix is also providing support to industry for compliance with the REACH regulations. The testing program includes a combination of both acute and chronic toxicity tests with a range of aquatic organisms. Data will be used to develop acute and chronic biotic ligand models, which will ultimately be used in the derivation of PNECs.



Nickel Secondary Poisoning Evaluation for the European Nickel Risk Assessment

Client: Nickel Producers Environmental Research Association

Parametrix is working with the Nickel Producers Environmental Research Association (NiPERA) to evaluate secondary poisoning (dietary) risks of nickel to aquatic and terrestrial birds and mammals. This evaluation follows a scientifically defensible approach regarding nickel exposure and effects in wildlife that must be balanced with certain requirements from the European Union Technical Guidance Document on Risk Assessment. The evaluation is being conducted in support of the ongoing European risk assessment for nickel.



Evaluation of the Toxicity of Cobalt to Aquatic Organisms and Derivation of Probable No Effect Concentrations/Ambient Water Quality Criteria

Client: Cobalt Development Institute

Parametrix designed and conducted laboratory tests to evaluate the toxicity of cobalt to aquatic organisms and to provide data suitable for the derivation of PNECs/AWQC in the European Union, Canada and the United States. In addition, Parametrix is also providing support to industry for compliance with the REACH regulations. The testing program includes a combination of acute and chronic toxicity tests with a range of aquatic organisms. Data will be used to develop acute and chronic biotic ligand models and this will ultimately be incorporated in derived PNECs.

Risk Assessment

Ecological and human-health risk assessments form the scientific basis of many regulatory decisions (e.g., Comprehensive Environmental Response Compensation and Liability Act [CERCLA], Resource Conservation and Recovery Act [RCRA]) in which protection of human health and the environment are critical. Our toxicologists are experienced in assessing risks for a wide range of conditions and needs including oil spills; prospective ("what if") assessments; historical contamination assessments (mining, industrial, etc.); residual risk from treatment or other remedial actions; and conducting risk assessments and preparing expert reports in support of litigation.

Expert Consulting and Testifying Support for Dioxin-Contaminated Mining/Refining Facility – Salt Lake City, UT

Client: Confidential

Parametrix is currently providing expert consulting services, as well as providing a testifying expert to support a confidential client in their litigation with a regulatory agency over potential ecological risk posed by levels of site contaminants and the degree of remediation that might be required. Parametrix reviewed reports prepared by the Plaintiff's ecological risk assessment expert and remediation expert and prepared detailed rebuttal reports on a point-by-point basis. Following depositions last fall, Parametrix is preparing for trial in fall 2008.

assuming settlement does not occur. Following the trial, Parametrix will continue to provide technical support for conducting any remaining studies and analyses to document the nature and degree of risk posed by site contaminants.

Expert Consulting Support for Contaminated Groundwater Impacts – Salt Lake City, UT

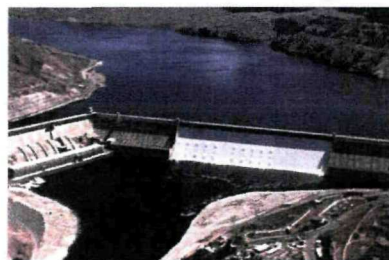
Client: Confidential

In 2002, this confidential client was notified that the soil and groundwater under their property was contaminated with chemicals from previous spills in the chemical storage yard next door. Indoor air samples were taken to determine if the chemicals had vaporized to levels that might be dangerous to the workers. Brine shrimp (client's product) were analyzed to see if the chemicals had concentrated in their product. Parametrix was asked to review the types of toxic effects that can be caused by the chemicals that were measured in the groundwater and brine shrimp, and to determine the potential for them to accumulate in the human food chain. Measured chemicals include effects on the neurological system, reproductive system, immune system, and liver and kidney functions. Several chemicals were determined, based on their physical properties, to have a high likelihood of accumulating in the food chain. A report was prepared to support counsel in their legal action against the company.

Investigations, Ecological and Human Health Risk Assessments of Slag in Upper Columbia River – Spokane, WA

Client: Confidential

Parametrix is currently evaluating existing and ongoing studies as part of a larger remedial investigation, risk assessment planning, and data collection effort underway for slag and other mine-related contaminants in the soils, sediment, surface water, and biota of the Upper Columbia River. Exposure of recreational and residential populations, including Native American tribes (Colville Tribal Nation, Spokane Tribal Nation), will be key components of the human health risk assessment. Particular emphasis will be placed on methods for evaluating impacts to culturally and spiritually significant resources of the tribes. Metals of particular concern include copper, lead, zinc, arsenic, and mercury. Slag bioavailability tests and other biometrics are likely to play a key role in the exposure and risk evaluations for both human and ecological receptors.



Parametrix, in concert with other members of the consultant team, is currently completing a screening-level risk assessment, preparing sampling and analysis plans for collection of a wide range of data at the 150-mile-long site, and supporting in-agency negotiations to define the nature and extent of contamination. These data will ultimately be used to characterize risk and determine the need (if any) for remedial activities to mitigate risk potential.

Ecological and Human Health Risk Assessments of Future Pit Lakes, Round Mountain and Gold Hill – Nye County, NV

Client: Kinross Gold Corporation

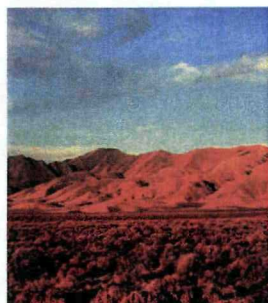
Parametrix has been retained to conduct risk assessments of future pit lakes at the Round Mountain Gold Mine Site. The objective of the risk assessments is to determine risks to avian wildlife, terrestrial wildlife, and human health receptors for the existing permitted future pit lakes (Round Mountain and Gold Hill) and the proposed expansion future pit lakes at both locations. Both the existing permitted and proposed expansion pit lakes risk assessments are being characterized using pit lake water quality model data provided by Round Mountain Gold Company. The pit lake risk assessments are being patterned after nationally accepted risk assessment guidance (e.g., EPA 1998; Parkhurst et al. 1995), and include the standard risk assessment components specified by the Nevada State Office of the Bureau of Land Management (2004) on conducting Pit Lake Risk Assessments (BLM 2004).



Ecological and Human Health Risk Assessment of Future Pit Lakes, Twin Creeks Mine – Golconda, NV

Client: Santa Fe Pacific Gold Corporation, Nevada (since purchased by Newmont Mining Corporation)

The Santa Fe Pacific Gold Corporation was seeking approval from the Bureau of Land Management to expand their gold mining operation at the Twin Creeks facility. As part of the environmental evaluation conducted for the environmental impact statement (EIS), the Bureau requested that Santa Fe Pacific conduct a risk assessment to assess impacts on wildlife



and human health. Specifically, we evaluated risks to wildlife from exposure to the future pit lake chemicals leached from the walls of the mining pit; risks to human health from exposure to the future pit lake chemicals for two different pit shape designs; and two separate pit mitigations (leaving the pit unfilled at the end of mining and backfilling the pit post-mining). The detailed risk assessment concluded that there were negligible risks to wildlife and human health from the future pit lake. This conclusion was based on recommendations by the risk assessors to the mining engineers that resulted in a redesign of the pit excavation plan to reduce and/or eliminate exposure pathways to wildlife and people. The risk

assessment identified structural engineering changes that would reduce or eliminate exposure potential, and supported a conclusion that backfilling the pit post-mining was unnecessary, something that would have cost Santa Fe Pacific several million dollars. The risk assessment contributed to the decision not to backfill made by the proponent and the Bureau, the Nevada Division of Wildlife, and the Nevada Division of Environmental Protection.

Selenium Investigation, Bioaccumulation Study and Ecological Risk Assessment – Magna, UT

Client: Kennecott Utah Copper

Since 1992, Parametrix has performed a variety of environmental studies for Kennecott Utah Copper, including ecological risk assessment, whole effluent toxicity testing, site-specific water quality standard development, sediment quality assessment, National Pollutant Discharge Elimination System (NPDES) permit compliance, bioassessment, mixing zone investigations, analytical chemistry method development, and remedial investigation (RI) activities. One of the more innovative projects performed for Kennecott involved use of probabilistic risk assessment on selenium for aquatic birds nesting in the South Shore Wetlands adjacent to Kennecott Utah Copper, using Bayesian techniques to optimize information on selenium exposure to birds expressed as egg selenium. Results from this assessment indicated extremely low risks, with most of the risk attributed to a single point source of selenium rather than in wetland area habitats.



Human and Ecological Risk Assessments to Support Copper Mine Expansion – Irian Jaya, Indonesia

Client: PT Freeport Indonesia

Parametrix provided services to assess the impacts of mine tailings on human health, wildlife, and aquatic life in the river, estuary, and ocean downstream of PT Freeport Indonesia's (PTFI) copper-gold mine in the province of Papua, Indonesia. A planned expansion of mining activities required an investigation and evaluation of risk potential to support necessary permits from the Indonesian government. Parametrix conducted numerous technical studies to support the preparation of comprehensive evaluations of current risk associated with existing mining levels, as well as evaluations of future risk under the planned mining expansion scenario. Studies included measurements in numerous site media (sediment, surface water, groundwater, fish, shellfish, invertebrates consumed by people and wildlife, soil, air); carefully designed surveys of the resource use habits and amounts by indigenous people; extensive studies of mangrove swamp impacts; modeling of bioavailable fractions of metals to support aquatic life evaluations; and toxicity of mine tailings to native and agricultural crops. Parametrix prepared a comprehensive evaluation of human and ecological risk based on all of these studies, which were conducted over a 3-year period. The risk assessments are being used to support PTFI's permits. Parametrix also presented the results of the risk assessments to a technical review panel consisting of local tribal leaders, distinguished academicians, non-governmental organizations, and government ministers. Currently, Parametrix is providing support to PTFI on updating the risk assessments to reflect additional data collected in the few years since the risk assessments were completed.

Parametrix Environmental Research Laboratory (PERL): Specialized Research and Toxicity Testing

We integrate scientific research with technical consulting services to better support our client's regulatory needs. The capabilities of PERL, combined with strong collaborative ties to industry and academic researchers, provide an unprecedented ability to conduct basic research on the ecotoxicology of metals, petroleum products, and pesticides, using both whole-organism and population-level tests, as well as molecular and suborganismal studies. Parametrix toxicologists regularly publish in the primary scientific literature and present study results at national and international scholarly societies.

Validation of Nickel Biotic Ligand Model Predictions for Selected Non-standard Organisms

Client: NiPERA

Parametrix has been involved with the development and validation of the nickel biotic ligand model (BLM) for purposes of developing site-specific regulatory frameworks. In addition, laboratory studies have investigated whether these BLMs can appropriately represent all organism classes/trophic levels (plants, invertebrates and fish) that constitute the entire species sensitivity distribution. As such, we tested the hypothesis that a trophic level-specific BLM could adequately predict chronic nickel toxicity for other species within that trophic level. Results suggested that the BLM developed using a crustacean could accurately predict chronic nickel toxicity for snails, insects, and rotifers.

Arid West Water Quality Research Project – Tucson, AZ

Client: Pima County Wastewater Management

Parametrix conducted scientific research in support of updating water quality standards and their implementation for effluent-dependent waters in the arid western United States. We led several scientific studies, including reviewing EPA ambient water quality criteria for protection of aquatic life, validating the BLM for copper, evaluating ammonia water-effect ratios (WERs) in very hard waters, and modifying EPA's recalculation procedure for derivation of site-specific water quality standards.



Evaluation of the Reliability of the BLM Predictions for Copper Toxicity in Waters Characteristic of the Arid West – Tucson, AZ

Client: Pima County Wastewater Management

Parametrix conducted a study of the reliability of EPA's new BLM for derivation of site-specific copper standards in effluent-dependent waters. The goal of this study was to validate earlier studies that suggested the BLM accurately predicted acute copper toxicity to the freshwater cladoceran *Ceriodaphnia dubia*. Our new project was to conduct testing with additional species (e.g., fathead minnows and *Daphnia pulex*), and using natural waters that encompassed a wide range of chemical characteristics of effluent-dependent waters in the

arid West. From these data, we concluded that the BLM generates appropriate criteria for the waters tested in this study when compared to the hardness-based criteria equation or by use of the WER. Although these historical site-specific methods are useful for surface waters with hardness ≤ 250 mg/L as calcium carbonate, the unique conditions of arid West streams would benefit more from site-specific methods based on the BLM that account for the influences of critical water quality variables (i.e., pH, dissolved organic carbon, alkalinity, calcium, magnesium, and sodium).

Evaluation of Behavioral Avoidance of Copper by Rainbow Trout

Client: Copper Development Association

Parametrix has been actively monitoring concerns related to the influence of copper on behavioral toxicity to Endangered Species Act-listed fish in the northwestern United States. The evolving issue of behavioral toxicology in salmonids has spawned from the realization that negative behavioral effects (e.g., neuroreceptor death, olfactory inhibition, and predator avoidance) may significantly decrease the ability of species to migrate, reproduce, and survive. The objectives of copper-avoidance testing in our laboratory have sought to confirm threshold concentrations of these sub-lethal effects and gain a better understanding of how water quality influences behavioral toxicity. To this end, our findings provide valuable data that can be incorporated into current regulatory frameworks that account for metal speciation and bioavailability (i.e., development of BLMs).



Development of Ambient Water Quality Criteria for Methyl-Tertiary Butyl Ether

Client: American Petroleum Institute

Parametrix personnel led a project to design and conduct a series of toxicity tests to determine the toxicity of methyl-tertiary butyl ether (MTBE) to a range of freshwater aquatic organisms. The goal of this effort was to develop the information necessary to derive AWQC and to work, in conjunction with the EPA, to develop a MTBE AWQC document. The project culminated in preparation of a draft AWQC document, which is currently under review by the EPA.



Design and Conduct of Multimedia Field Investigations

Rio Tinto Mine Site Investigation – Elko County, NV

Client: Rio Tinto Working Group

Parametrix provided technical support on investigation and risk assessment issues to the Rio Tinto Working Group, a consortium of companies with historical involvement at the Rio Tinto Mine Site in Elko, Nevada. Underground mining of a rich copper sulfide ore deposit began at the site in 1932 and terminated with the closure of the mine in 1947. During the ensuing years, there were a number of activities undertaken including re-working of the old tailings, leaching stockpiles of ore, leaching the underground workings, and exploring for additional mineral deposits. The property has been dormant since the late 1970s. Parametrix prepared a risk assessment work plan for one of two areas of the mine site that have been affected by historical releases. Parametrix also prepared an approved sampling and analysis plan (SAP) for the collection of multiple media: soil; terrestrial invertebrates; terrestrial plants/forbs; small mammals (shrews, voles, and mice); sediment;



aquatic macroinvertebrates; aquatic vegetation; and surface water. The goal of the SAP was to understand the nature and extent of contamination at the Site and to support risk assessment activities. Scientific collection permits were completed and submitted to allow collection of small mammals. A combination of live and snap traps were used for small mammal trapping. All sample media were also collected at identified reference areas. The data from these sampling efforts were used to prepare a detailed data report. The results were compared with a variety of human and ecological benchmarks and presented to resource trustees, the state, and the EPA to determine if further investigation and risk assessment activities were required.

Investigation of Slag and Tailings Releases to Aquatic System from Historic Refinery Site – Great Falls, MT

Client: Atlantic Richfield Company

Parametrix was retained to assist Atlantic Richfield in collecting data offshore of a historic copper/zinc refinery site in Great Falls, Montana to determine if the site qualified for addition to the National Priority List under the Superfund Program. The refinery released tailings and slag from refinery operations into the Missouri River over a period of several decades. The river in this location is a popular recreational destination and concern was raised over the safety of Site media to people, fish and wildlife. Parametrix assisted Atlantic Richfield in regulatory compliance requirements by designing a data collection program for the offshore aquatic environment (Missouri River) and by preparing for submission and approval a detailed Sampling and Analysis Plan (SAP). The SAP identified methods and procedures for collecting data on metal/metalloid concentrations (arsenic, copper, chromium, lead, mercury, manganese, selenium, zinc) in sediment, surface water, fish tissues and aquatic invertebrates both upstream and downstream of the Site (including reference areas). Parametrix field staff conducted the sampling. Results of the investigation were used to develop a detailed data report for submission to the EPA. Parametrix also conducted internal analyses of human and ecological risk potential and documented that the site did not pose a risk to health or the environment.

Multimedia Field Investigation and Ecological Risk Assessment at Mining/Refining Facility – Salt Lake City, UT

Client: Confidential

Parametrix recently assessed the potential for ecological risks posed by this confidential client's mining/refining facility current and historical waste management areas. Parametrix prepared approved sampling and analysis plans, obtained collection permits, and sampled for dioxins, furans, polychlorinated biphenyls, hexachlorobenzene, and a suite of metals and metalloids (including selenium) in several site media: soils, sediments, surface waters, aquatic invertebrates, small mammals, terrestrial plants, and terrestrial invertebrates. Parametrix also coordinated the conduct of an acute avian (mallard duck juveniles) toxicity study using site process water. The ecological risk assessment was focused principally on dietary exposure pathways to local and resident mammals as well as migratory birds. Results of the ecological risk assessment, and a separate human health risk assessment, are being used to determine whether adverse exposure and risk is posed by the current and historical waste management areas, and ultimately for crafting a strategy for future activities at the site.

Site Investigation, Engineering Evaluation, and Cost Analysis (SI/EE/CA) for Historical Phosphate Mine, Gay Mine Site – Pocatello, ID

Client: J.R. Simplot Company

Parametrix is leading the SI/EE/CA addressing selenium, cadmium, chromium, and zinc as key metals of concern from historical mining activities. Numerous waste rock piles remain and concern is high for runoff into the surface water of adjacent rivers and streams. In addition, several open pits remain, many of which contain water that may or may not be fed from groundwater. Investigation of railcar transport and potential spill areas, ore processing areas, pit lakes, adjacent wetlands, rivers and streams, and biotic and abiotic media quality are key aspects of the SI. Specialized studies of waste rock contaminant bioavailability and uptake into biotic resources (plant, animal) will support both the human and ecological risk assessments. Threatened and endangered species will receive special attention. Removal of existing buildings at the site, old processing equipment, removal of contaminated soils, implementation of best management practices (BMPs) for minimizing site releases to surface water, and evaluation of pit remediation and reclamation options will be key aspects of the EE/CA. Constituents of concern are primarily metals and metalloids with an emphasis on selenium contamination. Parametrix recently completed a comprehensive surface water sampling program of rivers, streams, creeks, and livestock watering locations to provide information on baseline conditions. Additional investigations are pending final negotiations with federal and state agencies.



Columbia Slough Remedial Investigation/Feasibility Study – Portland, OR

Client: City of Portland Bureau of Environmental Services

Parametrix conducted a multi-year, phased Remedial Investigation of over 29 miles of contaminated sediment and other media in this local backwater of the Columbia River outside of Portland that received significant pollutant loading from a series of 13 Combined Sewer Overflows as well as permitted and unpermitted stormwater discharges. Parametrix designed sampling strategies that were submitted in a series of Sampling and Analysis Plans for agency approval. Sampling of multiple environmental media (targeted and randomized sampling) over a three year period included: sediment, aquatic invertebrates, fish tissue and surface water. Priority pollutants were analyzed in all media. Screening and detailed human and ecological risk assessments were conducted. Sediment bioassays were conducted (acute, chronic) and Toxicity Identification Evaluations completed to identify chemical groups contributing to observed toxicity. Exposure surveys for local and recreational users were also a key part of the investigation with data supporting the detailed human health risk assessment. Parametrix also prepared the Engineering Feasibility Study which examined and ranked cleanup alternatives for cleanup of contaminated sediments, including CSO abatement and source control activities.

Regulatory Compliance

Parametrix routinely supports clients with their regulatory compliance requirements. We provide support for national (United States) and global regulatory programs, including:

- CERCLA (Comprehensive Environmental Response Compensation and Liability Act)
- RCRA (Resource Conservation and Recovery Act)
- TSCA (Toxic Substances Control Act)
- FIFRA (Federal Insecticide, Fungicide and Rodenticide Act)
- HPV Challenge (High Production Volume)
- REACH (Registration, Evaluation and Authorization of Chemicals)

Team toxicologists, biologists, risk assessors, and environmental chemists stand ready to bring cost-effective, issues-focused, scientific solutions to meet our clients' compliance requirements under all of the regulatory programs identified above. The European Union's new REACH program, in effect as of June 1, 2007, will affect companies doing business in or exporting to Europe. Parametrix is providing a wide range of support services to several clients to ensure regulatory compliance.

Lavaca Bay Investigation of Terrestrial and Aquatic Contamination at Former Chlor-Alkali Facility – Port Lavaca, TX

Client: Aluminum Company of America

Parametrix led the design and conduct of a multiple phase investigation into contamination of a local embayment and upland soils and groundwater at the site of a former chlor-alkali facility operated by ALCOA. Mercury was the chief chemical of concern though many other contaminants (metals, organics) were also investigated and evaluated in risk assessments.

Parametrix prepared SAPs and conducted sampling at the site. Chemicals of interest were investigated and evaluated in risk assessments for human and ecological receptors based on groundwater, surface water, soil, sediment, and a variety of aquatic tissue (invertebrates, fish, shellfish, and other fish and bird prey items) data. Inorganic and methyl mercury were extensively analyzed in these media as were other constituents of concern. Results were used to support the need for remedial action in upland and offshore environmental media and to support ongoing natural resource damage assessment claims.

Toxic Substances Control Act (TSCA) Chemical Registration Support

Client: Technohill Co. Ltd.

Parametrix is currently assisting a Japanese client with their application to EPA for registration of a titanium compound, manufactured in Japan, under TSCA. Registration is required for import and use in the United States. Parametrix is assisting the client with the preparation of the Premanufacture Notice (PMN) (the application), which includes review and analysis of human and mammalian toxicity data, worker safety data, the manufacturing process and annual production volumes, physical/chemical properties, and environmental fate and pollution prevention. Parametrix conducted a literature search to identify existing information on the compound of interest. Available mammalian, physical/chemical, and environmental fate data were identified for inclusion in the PMN application. Parametrix will also assist Technohill's Importer of Record with compliance requirements (e.g., restrictions, labeling, worker right-to-know, maintenance of proper distribution records, etc.) that arise following EPA's review of the registration application.

High Production Volume (HPV) Chemical Initiative: Organotin Consortium Support

Client: Organotin Stabilizer Task Force Consortium

As part of the voluntary global EPA/OECD High Production Volume (HPV) chemicals initiative, Parametrix provided a wide-range of technical and administrative support to the Organotin Environmental Programme (ORTEP) Association and its technical group, the Stabilizer Task Force (STF) Consortium. Contributing members of the international nonprofit consortia of organotin producers included chemical companies in North America, Europe, and Asia-Pacific. Services included compilation and organization of publicly available and company-proprietary chemical test data; conducting searches of databases and published literature for all available and relevant data on individual chemicals; evaluation and assessment of existing data quality (Klimisch), adequacy, and relevance; development of chemical and/or chemical category-specific test plans; preparation of requests for proposals (RFPs) for laboratory studies of physical-chemical properties, environmental fate, and aquatic and mammalian toxicology; study placement and study oversight/management; preparation of robust study summaries; summarization of key chemical (or chemical category) study data, exposure data, chemical hazards, and recommendations for additional work into Screening Information Data Sets (SIDS) and SIDS Initial Assessment Reports; development and update of chemical-specific International Uniform Chemical Information Database (IUCLID) dossiers for agency submission (United States and European Union); provided company- and consortia-specific support on ecological and human health risk and product stewardship issues; third-party manager of consortia finances (budget preparation and tracking, invoicing, subconsultant oversight), as well as task force liaison and arbitrator; liaison with sponsor country representatives; and development and maintenance of an

ORTEP Association Website for the dissemination of scientific and technical information on the environmental effects of organotin compounds. Parametrix is currently working with consortia and sponsor country representatives on completing post-SIDS Initial Assessment Meeting revisions to chemical submission documents and IUCLID database entries.

Update of Nickel IUCLID Dossier

Client: Nickel Producers Environmental Research Association

Parametrix is assisting NiPERA with updating their existing ecological and mammalian/human health IUCLID dossiers for several nickel compounds (Ni metal, Ni chloride, Ni sulfate, Ni nitrate, Ni acetate, and Ni carbonate). We are also conducting a quality check of numerous existing IUCLID entries for these compounds. Parametrix is conducting detailed literature searches and reviews of new study information since the IUCLID dossiers were last updated in 2002. Literature studies are reviewed against Klimisch criteria and appropriate study information entered into the IUCLID dossier. Updated ecological and mammalian/human health dossiers will be used to support the registration of these compounds under the European REACH initiative.

Our Team of Experts

Parametrix staff members have worked on a wide variety of projects for mining and related industrial sector clients as illustrated in the projects discussed on the previous pages. We make it a priority to match the expertise of key staff members to the technical issues faced by our clients. Our toxicologists and scientists provide a full range of technical and administrative support services to support clients in dealing with the many technical and regulatory challenges they routinely face.

Several of our staff provide scientific and toxicological consulting expertise to a number of metal industry groups. Our understanding of the risk and toxicology issues associated with metals and metalloids is unparalleled, particularly as they relate to site-specific impacts. Biosketches of several key project staff follow.

Support Services

Our technical staff is complemented by a wide array of project support services that include:

- Computer aided drafting and design (CADD)
- GIS services
- Surveying and mapping
- Word processing
- Technical editing
- Graphic design
- Library support services

Key Parametrix Staff

Bill Stubblefield, PhD

Bill is the technical director of aquatic toxicology for Parametrix's Toxicology Division. His areas of expertise include aquatic and wildlife toxicology as well as site-specific assessments and surveys. He has conducted a variety of research programs for the metals and mining industry that involved environmental issues resulting from the discharge of mine-associated waters and tailings, and the toxicity of metals and byproducts of metal mining. He has considerable experience in the oil and gas industry working on issues associated with the evaluation of impacts to aquatic and terrestrial species as a result of oil spills, refinery effluents, and the toxicity of petroleum products and process streams. He has authored more than 50 peer-reviewed publications and technical presentations. He has served as an invited participant at a number of scientific and regulatory conferences and serves as technical reviewer for several scientific publications. Bill also serves as a courtesy faculty member in the Departments of Environmental and Molecular Toxicology at Oregon State University.

Anne Fairbrother, DVM, PhD

Anne is a Senior Consultant at Parametrix. She provides services to a wide variety of public and private sector clients in ecological risk assessment and ecotoxicology, with an emphasis on terrestrial systems. Anne works in the areas of contaminated site assessment (particularly mine sites), metals risk assessment and research, pesticide regulatory science, and similar needs of the chemical and metals industries. She also supports state or national agencies through development of guidance documents, e.g., for metals risk assessments and through technical support for site-specific soil and water criteria development for wildlife protection. Anne was the lead author of the recent National EPA guidance: *Metals Risk Assessment Framework*. Anne's primary areas of expertise are in sublethal effects of chemicals on wildlife, particularly immunotoxicants and endocrine disrupting chemicals. She has been the recipient of several honors and awards from professional societies, and she holds courtesy appointments on faculties of Environmental Toxicology and Veterinary Medicine Departments. She has authored more than 75 scientific papers and has delivered over 100 seminars, workshops, or other technical presentations. She is on the Editorial Boards of several international journals, and has served in leadership positions in professional societies.

Sue Robinson, MSc

Suzanne (Sue) Robinson is a senior ecological and human health toxicologist and a senior project manager at Parametrix. Sue has been consulting with private and public sector clients for 23 years in numerous technical areas, including soil, sediment, water and air quality; mining impacts from historical and active mine sites; human and ecological toxicology; human exposure survey design and conduct; stochastic and probabilistic risk assessment (human, ecological); and natural resource damage assessment and litigation support. Ecological and human health risk assessments related to metals are a particular area of interest and expertise. Sue is highly experienced in developing strategic approaches to understanding and mitigating risk to both ecological and human receptors. She is also well experienced in the design, conduct, and management of multimedia field investigations to support human and ecological risk assessment concerns; developing risk-based standards (human, ecological); and designing site-specific studies to assess chemical toxicity, mobility, and bioavailability. She has managed projects of all sizes and complexity ranging from simple data risk screenings to the design of baseline programs to support comprehensive site characterizations and risk

assessments. Sue has also successfully worked with diverse stakeholder and interest groups that include technical specialists; state, local, and regional regulators; the public at large; and environmental interest groups. She is an active member of the Society of Environmental Toxicology and Chemistry and the Society of Toxicology.

Joseph Volosin, MSc

Joe is an ecotoxicologist with areas of expertise that include human and ecological toxicology, chemical transport and fate, and biomonitoring. He has been supporting private and public sector clients for over 20 years. Mining sites are an area of particular expertise. He currently manages and/or works on several projects that examine human and ecological risks, the monitoring of remediation sites using bioassessments, and the development of site-specific biological (Index of Biotic Integrity [IBI]) and chemical water quality criteria. Projects include evaluations involving chemical constituents in the following situations: leaching of metals from mine tailings; freshwater sediment contamination assessments; point and non-point source evaluation and biomonitoring of impacts due to mining and waste treatment systems on streams, rivers, and lakes in Arizona, Colorado, Montana, Nevada, New Mexico, Oregon, Utah, and Washington; contaminated surface and groundwater due to acid mine drainage; and deriving site-specific water quality guidelines for metals. Site-specific water quality guidelines for aluminum, cobalt, and manganese were derived for a site in Arizona. Other projects include evaluations involving biological communities: the development of biological criteria for the assessment of brown trout populations and macroinvertebrate communities; macroinvertebrate monitoring; evaluating habitat characteristics that affect macroinvertebrate communities (e.g., QHEI); collection and analysis of macroinvertebrates and periphyton; and site-specific toxicity evaluations. Statistical and multivariate techniques have been used in these and other assessments to evaluate macroinvertebrate communities.

Carrie Smith, MSc

Carrie is an environmental toxicologist at PERL. Carrie has experience coordinating and conducting aquatic, amphibian, and terrestrial ecology and ecotoxicology research with a strong emphasis on data management and analysis. She has participated in both laboratory and field-based investigations involving small mammals, amphibians, fish, and benthic invertebrates. Carrie has also worked on and managed several ecological and human health risk assessments and has authored technical presentations and papers on these topics.

Jeff Wirtz, MSc

Jeff is an ecotoxicologist in the Toxicology Group at Parametrix with over 8 years of experience in toxicology and risk assessment. He has been involved in research and assessment of mercury risks to aquatic ecosystems, and has written summary papers for such studies. Jeff also has worked on data compilation and analysis for terrestrial wildlife toxicity reference values and soil benchmarks for plants and soil invertebrates. Jeff's graduate work was focused primarily in Environmental Toxicology including courses in Ecotoxicology, Toxicants in the Environment, and Soil Microbiology and Biochemistry. His Masters thesis project used bioassays to evaluate the toxicity of anionic polyacrylamides that have been proposed as a means of controlling erosion at construction sites.

Allison Cardwell

Allison is the Laboratory Supervisor at PERL. She has over 7 years of experience coordinating and performing laboratory research projects. Her areas of expertise include aquatic and sediment bioassays and environmental chemistry. In particular, she has coordinated many laboratory research projects that utilize customized exposure systems (flow-through, early life stage, etc.) with freshwater and marine vertebrates and invertebrates. Allison has significant experience directing Good Laboratory Practice (GLP) research on the development of new water quality standards for chemicals (relative to EPA and European Union guidelines), developing site-specific water quality criteria under the Clean Water Act, supporting Ecological Risk Assessment exposure evaluations, and conducting compliance testing for NPDES permit holders.

Parametrix CVs

Bill Stubblefield, PhD

Position in Company:	Director, Parametrix Toxicology
Specialization:	Aquatic Toxicology
Nationality:	American
Education and Professional Status:	BA, Botany, 1982 PhD, Biological Sciences, Limnology, 1989
Membership of Professional Bodies:	<ul style="list-style-type: none">• Society of Environmental Toxicology and Chemistry• Society of Toxicology• American Society of Testing and Materials• American Chemical Society• Pacific Northwest Regional Chapter of the Society of Environmental Toxicology and Chemistry
Key Areas of Expertise:	<ul style="list-style-type: none">• Aquatic Toxicology• Aquatic Toxicity Testing Methods• Ecological Risk Assessment
Language Capabilities:	English

Key Professional Experience

Leviathan Mine Site Natural Resource Damage Assessment, Arco Environmental Remediation Limited – Alpine County, CA

Client: Davis, Graham & Stubbs LLP

As risk assessment specialist, Bill evaluated ecological risks associated with exposure of water column, benthic, and sediment-dwelling organisms to mining-related heavy metals contamination. He assessed environmental exposure concentrations empirically, and potential environmental effects using a combination of laboratory and field methods. He applied a multi-tiered approach to identify chemicals of concern in RD/RA.

Testing of Pilot System for Oil Tanker Ballast Water Treatment with Ozone

Client: BP Exploration, Inc.

Bill prepared a work plan and conducted a research project involving a full-scale test of a ballast water ozone treatment system to prevent introduction of non-indigenous aquatic species to U.S. coastal waters.

Evaluation of Aquatic Toxicity of Silver

Client: Photographic Imaging Manufacturers Association, Inc.

Bill designed and conducted a series of toxicity tests to determine the chronic toxicity of silver to freshwater aquatic organisms. The goal of this effort is to investigate and quantify the effects of water quality parameters (e.g., hardness, alkalinity, natural organic matter) on silver chronic toxicity. These data, in turn, will be used to further efforts in the development of a chronic biotic-ligand model for silver.

Update of Zn Toxicity Database

Bill reviewed current literature for acute and chronic toxicity of zinc to aquatic biota using standardized test methods, ranked them for scientific reliability and relevance, and prepared updated database of zinc toxicity data for use in ecological risk assessments.

Compilation of Pb Toxicity Database

Bill compiled a list of aquatic toxicity literature for lead. References were ranked for relevancy and reliability criteria, and compiled into a database for use by the lead industry in preparing ecological risk assessments.

Evaluation of the Toxicological Effects of the Exxon Valdez Crude Oil Spill – Prince William Sound, AK

Client: Exxon

Bill designed and supervised a toxicology testing program to assess the toxicity of spilled crude oil in Prince William Sound. This program included evaluation of potential effects to both sediment and water-column dwelling organisms as well as a characterization of the toxicity of weathered crude on terrestrial and avian species.

Natural Resource Damage Investigation for the Exxon Valdez Oil Spill- Exxon U.S.A., AK

Bill was project manager for a natural resource damage investigation on the possible environmental impacts of the Exxon Valdez oil spill. One of the worst oil spills in U.S. history, the tanker Exxon Valdez struck Bligh Reef and spilled an estimated 11 million gallons of North Slope crude oil into the waters of Prince William Sound, Alaska. The project included;

- Determining the toxicity of Prince William Sound water soon after the spill to assess possible effects on pelagic aquatic species. Acute and short-term chronic toxicity tests were conducted with water samples taken from the Sound, using the standard laboratory test species, sheepshead minnow (*Cyprinodon variegatus*), mysid shrimp (*Mysidopsis bahia*), and the alga *Skeletonema costatum*;
- Designing and conducting a program to evaluate the toxicity of spilled North Slope crude oil on the shorelines of Prince William Sound. The 3-year program investigated both spatial and temporal changes in the toxicity of oiled sediments in the Sound using amphipod (*Rhepoxynus abronius*) as a surrogate test organism for Alaskan species; Evaluating the toxic properties of naturally weathered Exxon Valdez crude oil with respect to avian and wildlife species. Toxicity tests were conducted using the surrogate species, mallard duck (*Anas platyrhynchos*) and the European ferret (*Mustela putorius*). These studies evaluated the potential for toxic injury to wildlife species that may have been exposed to weathered crude oil either through external contact or through dietary intake;
- Assisting in the design and implementation of a project to evaluate hydrocarbon concentrations in food items consumed by local subsistence fishermen in and around Kodiak Island, and tissues analyzed for hydrocarbon content. Conclusions were reached regarding the acceptability of the various food items through comparison of measured tissue concentrations and concentrations recommended as acceptable by various regulatory agencies; Selecting the sample archive location (Fort Collins office) for all samples collected in association with the Exxon Valdez Natural Resource Damage Assessment studies. The project involved establishing extensive quality control procedures for checking-in, logging, and shoring samples. In addition, a sample database was developed to permit tracking and retrieval of the more than 150,000 individual samples.

Evaluation of Metals Toxicity to Aquatic Organisms in Montana's Clark Fork River – MT

Client: ARCO Coal Company

Bill was project manager to evaluate potential effects of metals exposure on aquatic organisms in Montana's Clark Fork River and to support natural resource damage injury claims. This river has received input of heavy metals (e.g., copper, zinc) derived from old mining wastes. The project required the design and conduct of several types of laboratory studies to evaluate the roles of: metals bioavailability, potential metals interactive effects, site specific water quality, and metal sensitivity of resident fish species in determining the expected environmental effects of metals contamination. Bill developed and conducted a comprehensive testing and analysis program to derive unique water quality criteria for metals in accordance with the EPA's Indicator Species Approach; acute and chronic toxicity tests were conducted with field-collected and laboratory-reconstituted waters with invertebrates and cold/warm water fish species.

Surface Water Quality Standards Review Committee – AZ

Client: Arizona Department of Environmental Quality

Bill was a member of a state sponsored expert review panel to oversee scientific development of surface water quality standards for the State of Arizona.

Evaluation of the Toxicological Effects of a Large Diesel Fuel Spill

Client: Ashland Oil

Bill designed and supervised a large monitoring/laboratory testing program to assess the toxicity and impacts of spilled diesel fuel in the Monongahela and Ohio Rivers. Studies conducted included acute toxicity tests with collected river water samples and detailed analytical evaluation of contaminant concentrations.

Toxicity Identification, Confirmation, and Mitigation

Client: Mercury Marine

Bill identified carbon monoxide in toxic concentrations in a receiving stream and confirmed it as the cause of mortalities during in situ bioassays and as a contributing factor to fish die offs in the receiving water. He mapped carbon monoxide concentrations on a lake/riverine system and assisted Mercury Marine with the design and implementation of mitigative measures.

Ecological Risk Assessment for a Metals-Contaminated Superfund Site

Client: ARCO Coal Company

Bill evaluated ecological risks associated with exposure of water column, benthic, and soil dwelling organisms to mining related heavy metals contamination of reservoir sediments. Environmental exposure concentrations were determined and compared against literature based, regulatory based, and empirically based benchmarks of toxicity to provide a comprehensive risk characterization for the site. A multi-tiered approach was taken to identify potential chemicals of concern, screen them for toxicity, and make recommendations about site remediation. Results of the assessment were used to respond to a parallel ecological risk assessment prepared by the USEPA as part of the Remedial Investigation/Feasibility Study for the site.

Site-Specific Water Quality Criteria for Metals in the Upper Clark Fork River

Client: ARCO Coal Company

Bill developed and conducted a comprehensive testing and analysis program to derive unique water quality criteria for metals in the Clark Fork River that took into account the potential attenuating effects of site specific water quality characteristics on the toxicity of metals. In accordance with the USEPA's Indicator Species Approach, acute and chronic toxicity tests were conducted in site and laboratory reconstituted waters with invertebrates and cold/warm water fish species. The relative toxicity of metals in the two water types was evaluated to derive water effect ratios to be used in criteria development. Results of the studies indicated significantly reduced metals toxicity in site waters and provided the justification for site specific criteria modification.

Review of Terrestrial Toxicity Testing Methods and Regulatory Status

Client: Aluminum Company of America

Bill conducted a comprehensive literature review and prepared a white paper highlighting the advantages associated with including terrestrial toxicity testing strategies in site assessments and hazardous waste cleanup operations. He demonstrated the utility of substituting toxicity endpoints for chemical standards when setting site cleanup guidelines.

Evaluation of Aquatic Toxicity of Gasoline Additive-Methyl Tertiary-butyl Ether

Client: American Petroleum Institute

Bill designed and conducted a series of toxicity tests to determine the toxicity of MTBE to a range of freshwater aquatic organisms. The goal of this effort was to develop the information necessary to derive ambient water quality criteria (AWQC) and to work, in conjunction with USEPA scientists, to develop a MTBE AWQC document.

Evaluation of Aquatic Toxicity of Manganese – CO

Client: Climax Molybdenum

Bill designed and conducted a series of toxicity tests to determine the toxicity of manganese to a range of freshwater aquatic organisms. The goal of this effort was to develop the information necessary to derive ambient water quality criteria (AWQC) and to work, in conjunction with State of Colorado and USEPA scientists, to develop a state water quality standard for manganese.

Gasoline Spill Impact Assessment

Client: Santa Fe Southern Pacific

Bill designed and supervised an evaluation of impacts to a lotic environment as a result of a gasoline spill. The client desired a scientifically accurate evaluation of the short- and long-term impacts to exposed organisms in a freshwater stream. This program consisted of stream sampling for fish, water quality, and stream benthic invertebrates as well as toxicity testing of site waters.

Drilling Mud Reserve Pit Wastes Risk Assessment

Client: ARCO Coal Company

Bill was project manager for a risk assessment of the potential adverse environmental effects that may come about as a result of drilling mud reserve pit waste disposal practices. The overall project approach included estimations of the environmental fate of waste components and estimations of toxicologic consequences of waste exposure.

Evaluation of Heavy Metal Contamination in the Arkansas River – Leadville, CO

Client: Asarco, Incorporated

Bill was project manager for several types of investigations aimed at evaluating the potential impact of mining related, heavy metal discharges on the Arkansas River. Studies included a comparison of instream fish population data with those of other rivers in the state, ambient water toxicity studies to evaluate the effect of the discharges on the existing metal contamination, and site specific water quality criteria evaluations for possible application to the Arkansas River.

Evaluation of Bioaccumulation Potential of Drilling Mud Reserve Pit Wastes – North Slope, AK

Client: BP Exploration, Inc.

Bill served as project manager for investigations to evaluate the bioaccumulation potential of drilling reserve pit constituents in tundra on Alaska's North Slope. Contaminant concentrations in water, soil, phytoplankton, zooplankton, and terrestrial plants were evaluated, and the ecological hazard associated with oil drilling waste disposal/storage was assessed. Subsequent studies addressed issues associated with consumption of reserve pit constituents by caribou using pit areas as refuge from insect irritation.

Great Falls Historical Smelter/Refinery Site Investigation – Atlantic Richfield Company, Black Eagle, MT

Bill supported Atlantic Richfield in investigating the extent of contamination resulting from historical releases of smelter slag to the Missouri River, adjacent to the site of a historical smelter/refinery. He reviewed the prepared Sampling and Analysis Plan (including Quality Assurance Project Plan and Health and Safety Plan) to guide the collection of sediments, surface water and fish tissue. Bill also reviewed the draft data analysis report and the draft screening level risk assessment memorandum that was submitted to Atlantic Richfield Company.

Cobalt AWQC/PNEC Development

Client: Cobalt Development Institute

Bill led a project to design and conduct three tiers of toxicity tests to evaluate the toxicity of cobalt to aquatic organisms and to provide data suitable for the derivation of water quality criteria in the United States, Canada and the European Union. The first tier of the study generated an initial toxicological dataset that could be used to evaluate the effects of water quality parameters on cobalt acute toxicity to the cladoceran, *Ceriodaphnia dubia*, and to determine the importance of site-specific considerations for developing predictive models for water quality criteria modification. The second tier of testing used the approximate range of effects for cobalt determined in the first tier to conduct definitive acute cobalt toxicity tests with species that satisfy the USEPA AWQC dataset, and that also overlap with European Union requirements. Using the same tests organisms as the acute freshwater studies, the third tier of testing will consist of definitive chronic cobalt toxicity tests. Data from both the second and third tiers will be used to develop acute and chronic biotic ligand models, respectively.

Copper Criteria Support – New York, NY

Client: International Copper Association

As part of an Extant Criteria Evaluation (ECE), Bill conducted a laboratory study of copper toxicity in waters with hardness exceeding the USEPA's 400 mg/L upper limit for use of AWQC hardness adjustments. Acute toxicity tests with *C. dubia* were conducted at hardness levels ranging from ca. 300 to 1200 mg/L using reconstituted waters that mimic two kinds of natural waters with elevated hardness: 1) relatively

alkaline desert southwest streams (Las Vegas Wash, NV), and 2) low-alkalinity waters from a CaSO_4 -treated mining effluent in Colorado. The moderately-alkaline EPA synthetic hard water was also included for comparison. Contrary to expectations, copper toxicity did not vary as a function of hardness, but rather as a function of other aspects of ion composition. In particular, increasing alkalinity, magnesium, or sodium concentrations explained decreases in copper toxicity better than did either hardness or calcium concentrations. The Biotic Ligand Model generally predicted copper toxicity within $\pm 2X$ of observed EC_{50} 's, but predictions improved if magnesium and calcium were considered of equal importance in the model.

Lead Ambient Air Quality Criteria Document – OR

Client: Environmental Protection Agency

Bill managed the updating of the aquatic ecological effects portion of the USEPA's Lead Ambient Air Quality Criteria Document. Bill contributed to sections of the document pertaining to the effects of lead in the aquatic environment. Bill managed the team of authors, communicated with representatives from USEPA, participated in an author workshop in Washington D.C., and reviewed technical sections of the document developed by Parametrix and other participating consultants.

Nickel Testing with *C. Dubia* – Corvallis, OR

Client: NiPERA

Bill designed and led a project to identify and quantify the mitigating effects of various water quality parameters on nickel chronic toxicity to *C. dubia*. The overall objective of this study was to generate a toxicological dataset that could be used to develop a chronic biotic ligand model for nickel and to determine the importance of site-specific consideration for developing water effect ratios (WER). The mechanism of nickel toxicity (acute and chronic) also was evaluated as tissue-Ni concentrations in organisms continuously exposed to Ni for different durations.

Rio Tinto Risk Assessment Services – Elko County, NV

Client: Rio Tinto Working Group

Bill is providing technical support on investigation and risk assessment issues to the Rio Tinto Working Group, a consortium of companies with historical involvement at the Rio Tinto Mine Site in Nevada. Underground mining of a rich copper sulfide ore deposit began at the site in 1932 and terminated with the closure of the mine in 1947. During the ensuing years, there were a number of activities undertaken including re-working of the old tailings, leaching stockpiles of ore, leaching the underground workings and exploring for additional mineral deposits. The property has been dormant since the late 1970s. A risk assessment work plan was completed for one of two areas of the mine site that have been impacted by historical releases. An offsite area downstream of the Mine Site was extensively sampled to provide data on metals residues (including background concentrations) in several aquatic and terrestrial media, including: soil, sediment, aquatic and terrestrial invertebrates, aquatic and terrestrial plants, small mammals and surface water. Results were used to provide input to a screening level assessment to be used by the Trustees and Agencies in determining what additional work is required to complete remedial activities at the site.

Upper Blackfoot Mine Technical Support – Anaconda, MT

Client: Atlantic Richfield Company

Bill conducted a detailed review of the Engineering Evaluation/Cost Analysis (EE/CA) prepared by the USDA Forest Service's consultant on behalf of the Atlantic Richfield Company. The review focused on the technical validity and appropriateness of the risk assessments (human health and ecological), which were used to support the suggested remedial action.

Ecological Risk Assessments, Magnesium Processing Facility – Rowley, UT

Client: Confidential

Bill is an expert witness in ongoing litigation between the client and USEPA involving a Site in Rowley, Utah that is contaminated with a variety of chlorinated hydrocarbons. Bill provides senior review of all sampling plans and risk assessment reports prepared. He is the client's testifying expert for litigation regarding ecological impacts that may be posed by contamination at the Site.

Pre-Parametrix Employment

- 2002 – Present: Courtesy Faculty, Department of Environmental and Molecular Toxicology, Oregon State University, Corvallis, Oregon
- 1998 – 2002: Affiliate Faculty, Department of Environmental Health, Colorado State University
- 1990 – 2002: Affiliate Faculty, Department of Fisheries and Wildlife Biology, Colorado State University
- 1987 – 2002: ENSR Consulting and Engineering
- 1985 – 1987: Mobay Corporation; Health, Environment, and Safety Division
- 1983 – 1985: University of Wyoming, Fish Physiology and Toxicology Laboratory
- 1979 – 1983: Exxon Corporation, Research and Environmental Health Division

Principal Published Works

Stubblefield WA. 1979. Quantitative administration of insecticide vapors to rats. M.S. thesis. University of Kentucky, Lexington, KY.

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- DiToro DM, JA McGrath, and WA Stubblefield. 2007. Predicting the toxicity of neat and weathered crude oil: toxic Potential and the toxicity of saturated mixtures. Environ. Toxicol. Chem. 26(1):24-36.
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Presentations at Professional Meetings:

- Stubblefield WA, Dorrough HW. 1979. Quantitative administration of insecticide vapors to rats. Society of Toxicology Annual Meeting. March 1979.
- Stubblefield WA, Maki AW. 1982. Environmental risk assessment of refinery effluents. Cody Conference on Complex Effluents. August 1982.
- Stubblefield WA, Foster RB, Howard PH. 1983. An environmental toxicological assessment of phthalate esters. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1983.
- Phillips RD, Stubblefield WA, Dodd DE, Grice HC. 1984. Acute and subchronic inhalation of methyl DBCP. Society of Toxicology Annual Meeting. March 1984.
- McKee RH, Stubblefield WA, Scala RA. 1985. Evaluation of the carcinogenic activity of bitumen derived liquids. Society of Toxicology Annual Meeting. March 1985.
- Biles RW, Stubblefield WA. 1985. Acute toxicity battery of tar sands products and intermediates. Society of Toxicology Annual Meeting. March 1985.

- Bergman HL, Crossey MC, Steadman BL, Stubblefield WA, LaPoint TW. 1985. Water quality concerns: Organic pollutants. American Fisheries Society Annual Meeting. September 1985.
- Stubblefield WA, Steadman BL, LaPoint TW, Bergman HL. 1985. Acclimation induced changes in the toxicity of zinc, cadmium, and phenol in adult and fry rainbow trout. American Fisheries Society Annual Meeting. September 1985.
- Stubblefield WA, Steadman BL, LaPoint TW, Bergman HL. 1985. Acclimation induced changes in the toxicity of zinc and cadmium in adult and fry rainbow trout (*Salmo gairdneri*). Society of Environmental Toxicology and Chemistry Annual Meeting. November 1985.
- LaPoint TW, Stubblefield WA, Steadman BL, and Bergman HL. 1985. Acclimation induced changes in the toxicity of petroleum refinery wastewaters under laboratory and field conditions. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1985.
- Steadman BL, Farag A, Stubblefield WA, Bergman HL. 1986. Interactions of organic and metal detoxification pathways in rainbow trout. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1986.
- Stubblefield WA, Toll PA. 1987. Evaluation of temperature and warm water misting on hatching success in artificially incubated mallard duck eggs. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1987.
- Toll PA, Stubblefield WA, Nicolich MJ. 1987. Evaluation of methods for the determination of avian eggshell strength. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1987.
- Stubblefield, WA, Giddings JM, deNoyelles F. 1989. Mesocosms: their utility in the hazard assessment process. American Society of Testing and Materials Annual Meeting. April 1989.
- Stubblefield WA, Capps SW, Patti SJ. 1990. Toxicity of manganese to freshwater aquatic species. Society of Environmental Toxicology and Chemistry Annual Meeting. November 1990.
- Pillard DA, Stubblefield WA. 1990. Community structure analysis of benthic communities subjected to metal laden mine drainage. Society of Environmental Toxicological Chemistry Annual Meeting. November 1990.
- Cohen AS, Stubblefield WA. 1991. Toxicity of bromide to freshwater aquatic species. Society of Environmental Toxicological Chemistry Annual Meeting. November 1991.
- Stubblefield WA. 1991. Potential bioaccumulation of reserve pit constituents in tundra biota on Alaska's North Slope oil fields. Society of Environmental Toxicological Chemistry Annual Meeting. November 1991.
- Lawhead BE, Bishop SC, Stubblefield WA. 1992. Evaluating the exposure of caribou to toxic substance and North Slope drilling muds. North Slope Terrestrial Studies Workshop, February 1992. Anchorage, Alaska.

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- Cohen AS, Stubblefield WA. 1992. Bioaccumulation: Field evaluation and application in the ecological risk assessment framework. Society of Risk Analysis Annual Meeting. December 1992.
- Brumbaugh WG, Wiedmeyer RH, Ingersoll CG, Mount DR, Stubblefield WA. 1992. Milltown Reservoir - Clark Fork River, Montana: Chemical characterization of metals in sediments and pore water. Society of Environmental Toxicology and Chemistry Annual Meeting, Cincinnati, Ohio. November 1992.
- Ringer RK, Prince HH, Hancock GA, Stubblefield WA. 1993. An ecological risk assessment of weathered North Slope crude oil to avian wildlife following the Exxon Valdez oil spill. Society of Environmental Toxicology and Chemistry Annual Meeting, Houston, Texas. November 1993.
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- Cohen AS, Stubblefield WA, Hockett JR, Mount DR. 1993. Comparison of the sensitivity of three salmonid species during separate acute exposures to copper, cadmium, and zinc. Society of Environmental Toxicology and Chemistry Annual Meeting, Houston, Texas. November 1993.
- Stubblefield WA, Cohen AS, Hockett JR, Mount DR. 1993. Acute and chronic interactive effects of copper, zinc, and cadmium to rainbow trout and *Ceriodaphnia*. Society of Environmental Toxicology and Chemistry Annual Meeting, Houston, Texas. November 1993.
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- Boehm PD, Gilfillian ES, Page DS, Stubblefield WA. 1993. Application of sediment "triad" approach to a major oil spill assessment. The Exxon Valdez spill. Society of Environmental Toxicology and Chemistry Annual Meeting, Houston, Texas. November 1993.
- Pillard DA, Stubblefield WA. 1993. An evaluation of sediment grain size as a confounding factor in assessing toxicity in shoreline sediment samples. Society of Environmental Toxicology and Chemistry Annual Meeting, Houston, Texas. November 1993.

- Cohen AS, Stubblefield WA. 1994. Chronic toxicity of Clark Fort River sediment interstitial water to *Ceriodaphnia dubia* and rainbow trout. Society of Environmental Toxicology and Chemistry Annual Meeting. Denver, Colorado. November 1994.
- Cohen AS, Hockett JR, Stubblefield WA. 1994. Toxicity of pulse exposures of zinc, cadmium, and copper to pre-exposed trout and daphnia. Society of Environmental Toxicology and Chemistry Annual Meeting. Denver, Colorado. November 1994.
- Stubblefield, WA, Cohen AS. 1995. Application of the water-effects ratio (WER) for site-specific water quality criteria development for copper in the Clark Fork River (CFR). Society of Environmental Toxicology and Chemistry Annual Meeting, Vancouver, BC. November 1995.
- Cohen AS, Brady MD, Stubblefield WA. 1995. Changes in copper water-effect ratios in toxicity tests conducted at varying water hardness levels. Society of Environmental Toxicology and Chemistry Annual Meeting, Vancouver, BC. November 1995.
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- Hopkins K, Kangaonkar T, Parsons A, Stubblefield WA. 1996. Assessment of baseline sediment risks in the Tongass Narrows Waterway, Alaska. Society of Environmental Toxicology and Chemistry Annual Meeting, Washington, D.C. November 1996.
- Stubblefield WA, Burnett SL, Hockett JR, Naddy RB, Mancini ER. 1997. Evaluation of the aquatic toxicity of methyl tertiary-butyl ether (MTBE): Implications to refinery operations. American Petroleum Institute Spring Refining Meeting. San Diego, California. April 1997.
- Stubblefield WA, Burnett SL, Hockett JR, Naddy RB, Mancini ER. 1997. Evaluation of the acute and chronic aquatic toxicity of methyl tertiary-butyl ether (MTBE). American Chemical Society Annual Meeting. San Francisco, California. April 1997.

- Stubblefield WA, Baroch J, Dressen P, Spraker T, Getzy D. 1997. Evaluation of the toxic properties of acid mine drainage water to Snow Geese. Society of Environmental Toxicology and Chemistry Annual Meeting, San Francisco, CA. November 1997.
- Naddy RB, Barten K, Garrison T, Tucker S, Vertucci F, Stubblefield WA. 1997. Evaluation of benthic macroinvertebrate community composition and tissue residues in the Clark Fork River, Montana. Society of Environmental Toxicology and Chemistry Annual Meeting, San Francisco, CA. November 1997.
- Stubblefield WA, Naddy RB, Tucker S, Barten K, Christensen K, Hockett JR. 1997. Evaluation of metals contaminated sediments within depositional and riffle habitats in the Clark Fork River. Society of Environmental Toxicology and Chemistry Annual Meeting, San Francisco, CA. November 1997.
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- Mancini ER, Stubblefield WA. 1997. Physiochemical and ecotoxicological properties of gasoline oxygenates. Society of Environmental Toxicology and Chemistry Annual Meeting, San Francisco, CA. November 1997.
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- Stubblefield WA, Naddy RB, Tucker S, R Hockett JR. 1998. *In situ* evaluation of porewater metal concentrations in aquatic sediments. Society of Environmental Toxicology and Chemistry - Europe Annual Meeting, Bordeaux, France. April 1998.
- Naddy RB, Stubblefield WA, Christensen KP, Pillard DA, Tucker SA, Hockett JR. 1998. Evaluating the bioavailability of metals mixtures in sediments from the Clark Fork River basin. Society of Environmental Toxicology and Chemistry Annual Meeting, Charlotte, SC. November 1998.
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- Stubblefield WA, Christensen KP, Hockett JR, Steen A, Grindstaff J, Wong DCI, Arnold WR, Rausina G. 1998. Derivation of ambient water quality criteria for MTBE: Toxicity to selected freshwater organisms. Society of Environmental Toxicology and Chemistry Annual Meeting, Charlotte, SC. November 1998.
- Mancini ER, Steen A, Arnold WR, Rausina GA, Wong DCL, Gostomski FE, Davies T, Hockett JR, Stubblefield WA, Drott KR, Springer TA, Errico P. Preliminary calculations of freshwater and marine water quality criteria for MTBE. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.

- Naddy RB, Stubblefield WA, May JR, Tucker SA, Hockett JR. The effect of calcium:magnesium ratios on the acute copper toxicity to five aquatic species in laboratory waters. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Naddy RB, Vertucci FA, Stubblefield WA. Evaluation of exposure-effects relationships of metals in the benthic macroinvertebrate community in the Upper Clark Fork River, Montana. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Pillard DA, Naddy RB, Stubblefield WA. Trends in tissue burdens, media concentrations, and toxicity at Warm Spring Pond, Anaconda, Montana. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Long K, Ryan A, Van Genderen E, Karen DJ, Stubblefield WA, Naddy RB, Klaine SJ. Does the hardness-based water quality criteria accurately reflect response of aquatic organisms to copper in the soft waters of the southeastern US. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Stubblefield WA, Hockett JR, Pillard DA, Herbst DB. Application of a triad-based approach for evaluating the effects of acid mine drainage (AMD) in a high-mountain stream. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Gensemer RW, Playle RC, Stubblefield WA, Hockett JR. Aluminum bioavailability and toxicity of freshwater biota at circumneutral and higher pH. Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA. November 1999.
- Stubblefield WA, Hockett JR, Kramer JR, Wood CM, Paquin PR, and Gorsuch JW. Chronic silver toxicity: water quality parameters as modifying factors. Society of Environmental Toxicology and Chemistry Annual Meeting, Nashville ,TN. November 2000.
- Page D, Gilfillian E, Boehm P, Burns W, Maki A, Stubblefield W, and Parker K. Sediment toxicity values for a field study compared with sediment quality criteria for total PAH. Society of Environmental Toxicology and Chemistry Annual Meeting, Nashville ,TN. November 2000.
- Ward TJ, Boeri RL, Hogstrand C, Kramer JR, Lussier SM, Stubblefield WA, and Gorsuch JW. 2001. Chronic estuarine and marine silver toxicity: water quality parameters as modifying factors. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MA. November 2001.
- McGrath JA, Hellweger FL, Stubblefield WA, Maki AW, and DiToro DM. 2001. Predicting the effects of non-weathered and weathered crude oil using narcosis theory. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MA.. November 2001.
- Hellweger FL, McGrath JA Stubblefield WA, Maki AW, and DiToro DM. 2001. Equilibrium partitioning theory applied to Exxon Valdez crude oil. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MA. November 2001.

- Stubblefield WA, Gensemer RW, Naddy RB, Brix K, DeForest D, Paquin P, and Santore R. 2001. Evaluating copper toxicity to *Daphnia magna* in waters greater than 400 mg/L hardness. Society of Environmental Toxicology and Chemistry Annual Meeting, Baltimore, MA.. November 2001.
- Stubblefield WA, Wirtz JR, Naddy RB, DuFresne DL, De Schampelaere K, Brix KV, Ortego LS, and Schlegel CE. 2003. Modifying effects of water quality parameters on the chronic toxicity of nickel to *Ceriodaphnia dubia*. Society of Environmental Toxicology and Chemistry Asia-Pacific Annual Meeting, Christchurch NZ. September 2003.
- Clark, J, Stubblefield W, Fairbrother, A, and Dwyer R. 2003. Distribution of soil bioavailability parameters in Europe. 7th International Conference on the Biogeochemistry of Trace Elements. Uppsala, Sweden. June 2003.
- Oris, JT, Stubblefield WA, Smith CA and Maki AW. 2003. Solar radiation intensities and water attenuation coefficients in Prince William Sound, Alaska. Society of Environmental Toxicology and Chemistry Annual Meeting. Austin, TX. November 2003.
- DeForest, DK, Marx, K, Keithly, J, Santore, RC, Tobiasson, S, Stubblefield, WA and Brix, KV. 2003. Zinc risks from stormwater runoff at an urban airport. Society of Environmental Toxicology and Chemistry Annual Meeting. Austin, TX. November 2003.
- Gensemer, RW, Dethloff GM, Stubblefield, WA and Cooper WJ. 2003. Toxicity of ozonated ballast water to marine organisms. Society of Environmental Toxicology and Chemistry Annual Meeting. Austin, TX. November 2003.
- Stubblefield WA, Wirtz, JR, Naddy R, DuFresne DL, Brix KV and Ortego LS. 2003. Modifying effects of water quality parameters on the chronic toxicity of nickel to *Ceriodaphnia dubia*. Society of Environmental Toxicology and Chemistry Annual Meeting. Austin, TX. November 2003.
- Naddy RB, Stern GR, Rehner AB, Bell RA, Kramer JR, Wood CM, Paquin PR, Wu KB, Stubblefield, WA and Gorsuch JW 2003. Toxicity of silver to three freshwater organisms and effects of potential mitigating factors. Society of Environmental Toxicology and Chemistry Annual Meeting. Austin, TX. November 2003.
- Oris JT, Stubblefield WA, Smith CA and Maki AW. 2004. Relationship of water quality characteristics, solar radiation, and photoinduced toxicity of PAHs in Prince William Sound, Alaska. Society of Environmental Toxicology and Chemistry Annual Meeting. Portland, OR. November 2004.
- Smith CA, Stubblefield W, Clark J, Fairbrother A, Allen H, Schoeters I and Dwyer R. 2004. Distribution of soil and bioavailability parameters throughout Europe and the development of metalloregions. Society of Environmental Toxicology and Chemistry Annual Meeting. Portland, OR. November 2004.
- Stubblefield WA, Gensemer, R, Cooper W, Herwig R, Ruiz G. 2004. Ballast watertreatment strategies: evaluation of efficacy and post-treatment environmental concerns. Society of Environmental Toxicology and Chemistry Annual Meeting. Portland, OR. November 2004.

- Boeri R, Ward T, Hogstrand C., Kramer J, Lussier S, Stubblefield W., Gorsuch J. 2004. Marine water quality criteria development: the chronic toxicity of silver to sea urchins, *Arabacia punctulata*. Society of Environmental Toxicology and Chemistry Annual Meeting. Portland, OR. November 2004.
- Ward T, Boeri R, Hogstrand C., Kramer J, Lussier S, Stubblefield W. Wyskiel D, Gorsuch J. 2004. Silver water quality criteria development consideration of salinity and organic carbon influence on chronic marine toxicity.
- Wirtz J, Stubblefield W, De Schamphelaere KAC, Naddy RB, Ortego LS, Schlegel CE. 2004. Effects of water quality parameters on chronic nickel toxicity to *Ceriodaphnia dubia*. Society of Environmental Toxicology and Chemistry Annual Meeting. Portland, OR. November 2004.
- Stubblefield W, D DuFresne, D Robillard, D Peterson, J Gorsuch and C Staples. 2005. The evaluation of sparing soluble compounds: the toxicity of bis (2-ethylhexyl) adipate to *Daphnia magna* under static-renewal test conditions. Society of Environmental Toxicology and Chemistry European Annual Meeting. Lille, France. May 2005.
- Smith C, W Stubblefield, A Fairbrother, H Allen, I Schoeters, and R Dwyer. 2005. Distribution of soil bioavailability parameters throughout Europe and development of t-BLM based metalloregions. Society of Environmental Toxicology and Chemistry European Annual Meeting. Lille, France. May 2005.
- Phipps T, S Currie, W Stubblefield, C Farr, S Murphy, R Costlow, and M Thompson. 2005. Aquatic toxicity of mono- and dialkyltin chlorides to freshwater fish, daphnia, and algae. Society of Environmental Toxicology and Chemistry European Annual Meeting. Lille, France. May 2005.
- Phipps T, S Currie, W Stubblefield, C Farr, S Murphy, R Costlow, and M Thompson. 2005. Aquatic ecotoxicity of mono- and di-organotin stabilizers to freshwater organisms. Society of Environmental Toxicology and Chemistry European Annual Meeting. Lille, France. May 2005.
- Stubblefield W, J Oris, C Smith, and A Maki. 2006. Relationship of water quality characteristics, solar radiation, and photo-induced toxicity of PAHs in Prince William Sound (PWS), Alaska. Society of Environmental Toxicology and Chemistry European Annual Meeting. The Hague, Netherlands. May 2006.
- Van Genderen E, W Stubblefield, T Brock, and R Welton. 2006. Preliminary investigations into the aquatic toxicity of cobalt to freshwater biota. Society of Environmental Toxicology and Chemistry European Annual Meeting. The Hague, Netherlands. May 2006.
- Oris J, A Roberts, W Stubblefield, and A Maki. 2006. Gene expression in caged juvenile Coho Salmon (*Oncorhynchus kisutch*) exposed to the waters of Prince William Sound, Alaska (USA). Society of Environmental Toxicology and Chemistry European Annual Meeting. The Hague, Netherlands. May 2006.
- Wirtz, J.R. and W Stubblefield. 2006. Manganese Water/Sediment/Soil Quality Criteria Database: Review of Existing Data and Recommendations. Society of Environmental Toxicology and Chemistry Annual Meeting. Montreal, Canada. November 2006.

- Smith, C., E Van Genderen, W Stubblefield, T Brock, and R Welton. 2006. Preliminary investigations into the aquatic toxicity of cobalt to freshwater biota. Society of Environmental Toxicology and Chemistry Annual Meeting. Montreal, Canada. November 2006.
- Stubblefield, W, T Brock, K De Schamphelaere, D Heijerick, C Janssen, E Van Genderen, P Van Sprang, and R Welton. 2007. Cobalt: Application of an International Approach for Developing Environmental Criteria/Guidelines/Standards for Metals. Society of Environmental Toxicology and Chemistry Annual Meeting. Porto, Portugal. May 2007.
- Van Genderen EJ, W Stubblefield, KA De Schamphelaere, CE Schlekat. 2007. Validation of nickel Biotic Ligand Model predictions for selected non-standard organisms. Society of Environmental Toxicology and Chemistry Annual Meeting. Milwaukee, WI. November 2007.
- Stubblefield WA, EJ Van Genderen, TR Brock. 2007. Cobalt: Application of an International Approach for Developing Environmental Criteria/Guidelines/Standards for Metals. Society of Environmental Toxicology and Chemistry Annual Meeting. Milwaukee, WI. November 2007.
- Redman A, J McGrath, W Stubblefield, A Maki, D DiToro. 2007. Quantifying the concentration of crude oil microdroplets in oil-water preparations. Society of Environmental Toxicology and Chemistry Annual Meeting. Milwaukee, WI. November 2007.
- Stubblefield WA, EJ Van Genderen, CE Schlekat. 2007. Effects of nickel to marine organisms: Compilation of available data and derivation of a marine PNEC. Society of Environmental Toxicology and Chemistry Annual Meeting. Milwaukee, WI. November 2007.

Professional Activities:

Scientific Society Service

Society of Environmental Toxicology and Chemistry (SETAC)

- Past-President (2005)
- President (2004)
- Vice-President (2003)
- Board of Directors (1995-1998; 2002-2005)
- Program Chairman 1994 and 2002 annual meetings
- Chairman Publications Advisory Council (1995 2003)
- Member of Environmental Toxicology and Chemistry Editorial Board (1994-1997)
- Chairman Professional Opportunities Committee (1992 1995)
- Committee member Publications Committee (1989 1992) and the Nominations Committee (1985 1987)
- Assistant Editor of the Society of Environmental Toxicology and Chemistry Newsletter
- Associate Editor Society of Environmental Toxicology and Chemistry Special Publications.

Invited Conferences/Program Reviews:

Surface Water Quality Standards Review Committee for the Arizona Department of Environmental Quality (1989-1990).

U.S. Environmental Protection Agency Workshop on Mesocosms. Duluth, Minnesota, September 14-17, 1987.

U.S. Environmental Protection Agency Complex Effluent Program Review. September 1990.

U.S. Environmental Protection Agency, ECOTOX Database Review, Duluth, Minnesota. August 1994.

U.S. Environmental Protection Agency, Science to Achieve Results (STAR) Fellowship Review, Washington D.C. 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008.

U.S. Environmental Protection Agency, Peer-reviewer for National Sediment Inventory, Washington DC, 1996, 1999.

U.S. Environmental Protection Agency, Science Advisory Board, Multimedia, Multipathway, and Multireceptor Risk Assessment (3MRA) Model System Panel, Washington DC, 2003.

U.S. Environmental Protection Agency, Science Advisory Board, Framework for Inorganic Metals Risk Assessment Review Panel, Washington DC, 2005.

SETAC Pellston Conference on Environmental Hazard Assessment of Effluents. Cody, Wyoming. August 1982.

SETAC Pellston Conference on Avian Toxicity Testing Methods. Pensacola, Florida, December 1994.

SETAC Pellston Conference on Sediment Risk Assessment, Pacific Grove, California, April 1995.

SETAC Pellston Conference on Reassessment of Metals Criteria for Aquatic Life Protection, Pensacola, Florida, February 1996.

SETAC Pellston Conference on Reevaluation of the State of the Science for Water Quality Criteria Development; Gregson, Montana, June 1998.

SETAC Pellston Conference on Predicting Ecological Impacts from Laboratory Toxicity Tests; Cornwall, Quebec, Canada, May 1999.

SETAC Pellston Conference on The Role of Dietary Exposures in the Evaluation of Risk of Metals to Aquatic Organisms; Florsinent, British Columbia, Canada, August 2002.

SETAC Pellston Conference on Persistent, Bioaccumulative, and Toxic Materials (PBT); Pensacola, FL, May 2003

Metals Environmental Risk Assessment Guidance (MERAG) Science Consolidation Workshop (Workshop chair); London, UK, May 2005.

SETAC Technical Workshop on Environmental Quality Standards; Faringdon, Oxfordshire, UK, August 2006.

Academic Courses or Professional Continuing Education:

University of Wisconsin, Madison Department of Engineering Professional Development Program. Understanding Aquatic Toxicity Testing, October 1992, Anchorage, Alaska.

Colorado State University - Department of Fisheries and Wildlife, Environmental Toxicology, Spring 1990.

Colorado State University - Department of Environmental Health, Environmental Risk Assessment, Spring 1996/1998/2000/2002.

Oregon State University - Department of Molecular and Environmental Toxicology, Ecological Risk Assessment, Winter 2003/2004/2005/2006/2007/2008.

Oregon State University - Department of Molecular and Environmental Toxicology, Aquatic Toxicology, Spring 2005/2006/2007.

Anne Fairbrother

Position in Company:

Director, Parametrix Toxicology

Specialization:

Environmental Toxicology and Veterinary Sciences

Nationality:

American

Education and Professional Status:

BSc, Wildlife and Fisheries Biology, 1976

DVM, Veterinary Medicine, 1980

MSc, Veterinary Science, 1982

PhD, Veterinary Science, 1985

Membership of Professional Bodies:

- Board of Directors, Past President: Society of Environmental Toxicology and Chemistry
- Council Member, Past President: Wildlife Disease Association
- Past President: American Association of Wildlife Veterinarians
- Society for Risk Analysis

Key Areas of Expertise:

- Terrestrial toxicology and risk assessment
- Wildlife and plant toxicity testing
- Facilitation of technical meetings and workshops
- Ecological risk assessment

Language Capabilities:

English

Key Professional Experience

Metals in the Human Environment Science Network – Canada

Client: University of Guelph

Anne serves on a Scientific Review Panel for the network of Canadian researchers studying fate and effects of metals in the environment. MITHE-SN is a consortium of industry, government, and academia that conducts research in support of science-based environmental and human health risk assessments for metals in water, soil and food, within well articulated and planned inter-disciplinary research themes. This work includes developing models for understanding and predicting bioavailability of metals in soils (a terrestrial BLM), uptake of metals into plants (gardens and crops), effects of metals on aquatic and terrestrial biota, and potential health effects from metals on playgrounds, in dust, and around mines. The panel meets annually to review the progress and direction of the research projects.

<http://www.mithe-rn.org/index.cfm>

Science Advisory Panel – British Columbia Contaminated Sites Program

Anne has participated as a member of this panel for nearly 5 years, with an emphasis on terrestrial issues. In particular, she served on a subcommittee to revise the contaminated soil guidelines (after having reviewed the original guidelines 10 years previous). She also provides expert technical review of updates to the contaminated site assessment protocols.

Expert Advisory Panel – British Columbia

Client: Elk Valley Selenium Task Force

Anne served as an expert reviewer and discussant for the Elk Valley Selenium Task Force, a consortium of industry and regulators in British Columbia. The purpose of the Task Force is to provide data and an approach to reducing and mitigating risks to the environment from selenium released as a result of increased coal mining in the Elk Valley, BC. The Panel reviewed the past 10 years of data and provided expert opinion on the next steps for data generation, monitoring, and decision-making.

Invited Workshop: Setting soil standards for metals – Sydney, Australia

Client: Society of Environmental Toxicology and Chemistry and CSIRO (Australia)

Anne will attend a by invitation only workshop in July on setting soil standards for metals. This workshop will bring together about 30 experts from around the world to discuss the issues about setting soil standards for metals, including such topics as bioavailability, soil residence time, effects levels for plants, wildlife, and soil organisms, and scientific / data gaps. A report will be prepared and published by the Society of Environmental Toxicology and Chemistry (SETAC).

Framework for Metals Risk Assessment – US EPA

While an employee with the US EPA, Anne was one of the lead authors for writing the *Framework for Metals Risk Assessment*. This policy-setting document provides guidance on the underlying issues for all aspects of metals risk assessment, including environmental chemistry, transport and fate, and effects (human health, terrestrial, and aquatic). The document was formally adopted by the Agency as the basis for how such assessments should be done on March 8, 2007.

<http://www.epa.gov/osa/metalsframework/>

Wide Area Risk Assessment – Trail, BC

Client: Teck Cominco

Anne was a senior advisor on the terrestrial ecological risk assessment around the lead/zinc smelter at Trail, BC. This was the first wide area assessment conducted in BC after passage of the contaminated sites legislation. The approach included sampling soil on a stratified random design to characterize nature and extent of contamination, collection and analysis of plants and soil organisms to determine site-specific exposures and trophic transfer factors, assessment of risk to wildlife through food chain models and field observations, and field studies of plant community composition. The final report was issued late 2007.

Stabilizer Task Force Support – Tarrytown, NY

Client: ORTEP (organotin) Association

Anne provided technical and managerial support to the Stabilizer Task Force (STF) for submission of a screening information data set (SIDs) of information to the OECD's High Production Volume (HPV) data call in program. The STF is a consortium of 12 organotin producers who are sponsoring 27 chemicals to the HPV program through the ICCA. Parametrix reviewed the available literature on physical/chemical properties, environmental fate, ecotoxicity, and human health effects for all the chemicals, and entered appropriate data into the IUCLID database system. Tests were placed with contract laboratories to fill in data gaps. Structure-activity relationships and chemical categories were developed to reduce the need for testing. Parametrix also developed Test Plans, SIARs, and dossiers for submission to the regulatory authorities.

Ecological Technical Advisory Panel (ETAP)

Client: ILZRO and ICA

For the past 10 years, Anne has served as a member of a small expert advisory panel to the metals industry. The panel is composed of 5 experts from the US, Europe, and Australia that provide advice on emerging issues related to metals in the environment. This helps industry position their research efforts to develop data and information in anticipation of existing and new regulatory requirements such as the European Water Framework Directive and REACH. The Panel meets annually for formal consultations and provides ancillary support on an as needed basis during the remainder of the year.

Site-specific Ecological Risk Assessment – Spokane, WA

Client: Confidential

Anne is managing the conduct of an ecological risk assessment for over 175 miles of sediment contaminated with metal enriched slag discharged from a smelter as well as a variety of other chemicals from other sources. She coordinates the scoping and delivery of multiple work products dealing with the development of the site investigation and baseline ecological risk assessment. Anne also regularly attends meetings with the regulatory agencies and other project stakeholders to gain input to the ecological risk assessment and provide feedback on ecological risk assessment activities.

ARAMS Terrestrial Toxicity Database – Aberdeen Proving Grounds, MD

Client: U.S. Department of Defense -- USACHPPM DTOX Health Effects

Developed a searchable database of toxicity threshold information for terrestrial wildlife (birds, mammals, amphibians, reptiles). Included general project description and ranking of data quality. Users can select thresholds appropriate to their specific risk assessment. This database is an integral part of the Department of Defense risk assessment software, ARAMS (Adaptive Risk Assessment Modeling System) available as a public access program at: <http://el.erdc.usace.army.mil/arams>.

ECOFRAM Probabilistic Ecological Risk Assessment – Washington, DC

Client: American Crop Protection Association

Anne assisted in the development of a probabilistic risk assessment model for determining risk to birds using agricultural fields. Exposure to both flowable and granular pesticides was simulated. The model was developed using the Analytica® decision-based software system. The model was developed for industry as part of the ECOFRAM process sponsored by the U.S. EPA. The basic model is applicable to exposure to any contaminant, and contains a fate module that allows input of degradation rates over time.

Canadian Occidental Petroleum Expert Review – Squamish, BC

Client: B.C. Ministry of Attorney General

Anne acted as a certified expert and provided review of documentation and approach for assessing effects of mercury contamination from a large chlor-alkali processing plant on the coast of British Columbia.

Channel Deepening Reconsultation – Lower Columbia River, OR & WA

Client: Port of Portland

Anne supported the Port of Portland in a reconsultation with Federal regulatory agencies regarding the proposed dredging and deepening of the shipping channel in the Columbia River, from the mouth of the river to the confluence with the Willamette River, 101 miles upstream. Channel deepening was required in selected

spots to accommodate larger container ships coming to port in Portland. There was controversy over potential effects to habitat of endangered salmon and sea birds, particularly in regard to historic sediment contamination. Anne and colleagues from Parametrix reviewed toxicity data in a risk context, assisted the Port with formation of an expert review panel, and facilitated public meetings to collect input on the issues. The outcome was dependent up on a subsequent re-review of the regulatory agencies (state and federal) on the available data, and appropriation of funds from the U.S. Congress for operationalizing the project.

HEVI Shot Registration – Sweet Home, OR

Client: Environ Metal

Anne wrote a Tier I assessment and supervised the conduct of toxicity and exposure studies for registration of a new non-toxic shot for waterfowl hunting. The U.S. Fish and Wildlife Service has jurisdiction over which shot can be used, and must make a determination of whether or not the material in the shot poses risk to waterfowl or the environment. Anne successfully completed the registration process under the new regulations which allow selected testing rather than a complete battery of tests. Information has been submitted to Environment Canada for review.

Kendall Mine – Lewistown, MT

Client: CR Montana Corp

Anne conducted a site-specific assessment of residual risks from closure of the Kendall Mine in Montana. This mine had two open pits that were partially filled. Water seepage into the pit, as well as old waste rock piles, continued to present a potential for exposing plants and wildlife to elevated levels of various metals. Anne assessed the information and provided a report about current and future risks to these ecological receptors.

Ecological Risk Assessment – Delaware

Client: Malcolm Pirnie

Anne provided support for the ecological risk assessment of a marsh along the Delaware River that was adjacent to a chemical plant. Historic contamination from a variety of pesticides and other organic pollutants was present on the site. Current and future risks were assessed, and source apportionment conducted to allocate risks to the chemical plant or general river deposition.

Pre-Parametrix Employment

- 2006 – 2007: Associate Director for Science, U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Western Ecology Division, Corvallis, Oregon
- 2002 – 2006: Chief, Risk Characterization Branch, U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Western Ecology Division, Corvallis, Oregon. Supervisory life scientist.
- 1999 – 2002: Director and Senior Ecotoxicologist, Parametrix Inc. Corvallis, Oregon. Terrestrial ecotoxicology.
- 1994 – 1999: Senior Wildlife Ecotoxicologist, Ecological Planning & Toxicology (ep&t). Animal testing, study management, ecological risk assessment.

1992 – 1994: Chief, Ecotoxicology Branch, U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, Oregon. Supervisory ecologist.

- 1986 – 1992: Research Ecologist, U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, Oregon.
- 1987 – 2003: Courtesy Associate Professor, College of Veterinary Medicine, Oregon State University, Corvallis, Oregon.
- 2003 – Present: Courtesy Associate Professor, Department of Environmental and Molecular Toxicology, Oregon State University, Corvallis, Oregon

Principal Published Works

- Fairbrother, A., R. Wentsel, K. Sappington, and W. Wood. 2007. Framework for metals risk assessment. *Ecotox. Environ. Safety*. 68:145–227
- Nagy, L.R., A. Fairbrother, J. Orme-Zavaleta, and M. Etterson. 2007. The intersection of independent lies in ecological risk assessment. *Hum. Ecol. Risk Assess.* 13: 355-369.
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- Roelofs, W., D.R. Crocker, R.F. Shore, D.R.J. Moore, G.C. Smith, H.R. Akcakaya, R.S. Bennett, P.F. Chapman, M. Clook, M. Crane, Dewhurst, P.J. Edwards, A. Fairbrother, S. Ferson, D. Fischer, A.D.M. Hart, M. Holmes, M.J. Hooper, M. Lavine, A. Leopold, R. Luttik, P. Mineau, S.R. Mortenson, D.G. Noble, R.J. O'Connor, R.M. Sibly, M. Spendiff, T.A. Springer, H.M. Thompson, and C. Topping. 2005. Case Study Part 2: Probabilistic modelling of long-term effects of pesticides on individual breeding success in birds and mammals. *Ecotoxicol.* 14(8):1 – 29.

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Peer-reviewed books and book chapters:

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Lewis, M. A., A. Fairbrother, and R. E., Menzer. 2007. Methods in environmental toxicology. in A.W. Hayes, ed. Principles and methods of toxicology. 5th ed. Taylor and Francis, Philadelphia, PA.

Fairbrother, A. and B. Hope. 2005. Terrestrial Ecotoxicology. In: Wexler, P. (Ed.). Encyclopedia of Toxicology (2nd edition). Elsevier: Oxford. pp. 138 - 142.

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Suzanne “Sue” Robinson

Position in Company:	Senior Toxicologist, Senior Project Manager
Specialization:	Environmental & Wildlife Toxicology and Risk Assessment
Nationality:	American
Education and Professional Status:	BSc, Biological Sciences, 1982 MSc, Environmental & Wildlife Toxicology, 1985
Membership of Professional Bodies:	<ul style="list-style-type: none">• Society of Environmental Toxicology and Chemistry• Society of Toxicology• Society for Risk Analysis
Key Areas of Expertise:	<ul style="list-style-type: none">• Terrestrial Toxicology• Human Health Toxicology• Ecological and Human Health Risk Assessment• Site Assessment Strategies and Cleanup
Language Capabilities:	English

Key Professional Experience

Aquatic and Wildlife Risk Assessment Downstream from Copper Mine – Lihir

Client: OK Tedi Mining Ltd.

Sue conducted a screening-level risk assessment SLRA for people exposed to tailings releases metals, milling reagents from the Ok Tedi mine in the Fly River system. Risk potential was evaluated for exposures occurring from the Ok Tedi headwaters out to Torres Strait. The SLRA identified lead, cadmium and inorganic arsenic as posing potential risks to people through incidental sediment and aquatic food consumption pathways. Results of the SLRA were used to assist Ok Tedi in their tailings management practices. Sue also provided peer review of the ecological risk assessment performed for the Ok Tedi mine as well.

Aquatic Evaluation of Mine Tailings in a Marine Environment

Client: Kennecott Utah Copper

Sue prepared an evaluation of the potential for fish contamination by copper from potential deep water submarine tailings disposal for a proposed gold mine on Lihir Island. Tissue concentrations were estimated using copper bioconcentration factors and these concentrations provided input into an evaluation of risk associated with fish consumption. Lacking site-specific information on fish consumption rates, default exposure parameters derived by the United States Environmental Protection Agency were used to evaluate risk to people consuming fish caught within an assumed mixing zone offshore of the proposed discharge pipe.

Conda Mine Wildlife Risk Assessment – Pocatella, ID

Client: J.R. Simplot Company

Sue conducted a screening level risk assessment to determine if concentrations of selenium found in plant forage and surface water at the Conda Mine Site could have been responsible for the observed mortalities of sheep using parts of the reclaimed mine as foraging pasture. Sue reviewed pathology reports and conducted risk analyses to determine through several lines of evidence that the sheep mortalities could not

conclusively be linked to selenium contaminated forage and water alone and that poor animal husbandry practices by the flock owners may have played a key role in stressing the animals and contributing to their deaths.

Assessment of Ecological and Human Health Risks Downstream from Gold Mining Activities – Porgera, Papua, New Guinea

Client: Porgera Joint Venture (PJV)

As part of an international team, Sue conducted a screening-level risk assessment SLRA of potential health risks associated with mine tailings present in the Strickland River, Papua, New Guinea. The SLRA was conducted for the Porgera Joint Venture PJV gold mine to assess the effectiveness of its environmental monitoring plan in detecting impacts from the metals released in the tailings and wastewater. Mercury was a particular metal of concern because villagers 150 miles downstream of the mine contained some of the highest hair mercury residues recorded anywhere prior to commencement of mine operation. Food habits of the villagers were considered in the preparation of the SLRA. Hair mercury data was also used in the SLRA as part of an overall weight of evidence on the screening-level risks predicted. Results of the SLRA were used to identify the data needed for conducting a detailed human health risk assessment for PJV's mine tailings.

Assessment of the Ecological and Human Health Risks Downstream from Copper Mining – Irian Jaya, Indonesia

Client: P.T. Freeport Indonesia Co.

Sue conducted a comprehensive risk evaluation of the potential health risks posed by exposure to copper mine tailings to both endemic and migratory peoples living in a broad area impacted by copper rich mine tailings released from one of the worlds largest copper mines. Highland, lowland and estuary regions within the study area were thoroughly evaluated. The human health risk assessment HHRA, and the accompanying Aquatic and Plant & Wildlife risk assessments, have been described by some members of the mining community as one of the largest and most comprehensive mining risk assessments conducted to date. The HHRA relied on an abundance of site-specific and specialized study data, with many of the studies designed by Sue and other members of the Parametrix Team. Media evaluated in the HHRA included air, sediments, surface water, groundwater fish tissue, invertebrate tissue, fruits and vegetables. Several key studies supporting the HHRA included bioaccessibility in vitro testing of tailings constituents copper, arsenic in deposited and suspended tailings and in invertebrate tissues; speciated arsenic concentrations in freshwater and estuarine fish and invertebrates; tailings constituent concentrations in sago palm starch and grubs both of which are culturally significant food items and additional targeted surveys of soil and water use by local people in highland, lowland and estuary settlements. The HHRA and other risk assessments are currently under review by an international panel consisting of government, non-government and academic institutions but have largely been accepted as scientifically rigorous. Results of the HHRA and other risk assessments are being used by PTFI in their tailings management and mine expansion activities.

On-Call Environmental Services – Portland, OR

Client: City of Portland

Sue provided on-call environmental services to the City over several years in support of on-going management and cleanup of the Columbia River Slough. Some of the services Sue provided included reviewing literature and other publications on a variety of chemicals and issues and preparing white papers. She also developed sampling and analysis plans for use by the City for sediment and fish tissue sampling in the Columbia Slough. She also reviewed other contractor work plans and provided data base analysis support to the City's data base analysts.

Cardinal On-Call Services – WA and SC, WA

Client: Richardson, Plowden, Carpenter

Sue provided on-call support services for this producer of organotin stabilizer compounds. Services to date have included public relations support on chemical toxicity issues from various press releases. She has also provided reviews of technical documents related to the toxicity of organotin compounds discharged from a waste water treatment plant receiving Cardinal wastewater to a river system that supports a range of biota as well as human uses recreation, potable water.

Crompton On-Call Services – Tarrytown, NY

Client: Chemtura Corporation

Sue provides ongoing mammalian and human health toxicology and risk assessment support to Crompton Corporation, a manufacturer of organotin stabilizer compounds. Services include preparing detailed toxicological summaries for specific organotin compounds; critically reviewing new organotin toxicology studies Company sponsored or from the peer reviewed scientific literature, providing product stewardship support, preparing brochures and other summary papers on organotin toxicity and fate properties for use by Crompton's toxicologists and external customers. Sue also reviewed health risk assessments for organotin compounds prepared by European regulatory agencies, assisted with public relations issues addressing organotin toxicity and risk and prepared risk assessments to support product stewardship for specific exposure scenarios of concern to Crompton Corporation. She also was a primary contributor to a chapter on the mammalian toxicity of butyltin compounds in a recently published book on organotin compound toxicity.

Columbia Slough Habitat/Biological – Portland, OR

Client: City of Portland

Sue served as project manager for a multi-million dollar risk-based sediment remedial investigation and feasibility study RI/FS conducted at the Columbia River Slough, a major backwater supporting human activities, fish and wildlife populations. Chemicals have been entering the Slough for decades through permitted and unpermitted point sources, non-point discharges and through 13 Combined Sewer Overflows CSOs in the lower portion of the Slough. The investigation examined the nature and extent of chemicals occurring in the sediments, pore water and fish tissue. Exposure surveys of people fishing from the Slough were conducted and provided key input to screening-level and baseline risk assessments performed. The baseline risk assessment for the Slough represented the first probabilistic assessment conducted under the newly revised Cleanup Rules in Oregon. Bioassays and biosurveys were a key part of the ecological risk assessment. Following preparation of the draft feasibility study evaluating cleanup options for the Slough, the entire program approach designed by Parametrix was peer-reviewed and given high marks by members of the USEPA Seattle, New York working on similar sediment projects, The Cadmus Group, Battelle Northwest, and from a respected University in Virginia.

Diffuse Sources of Copper in the Environment – New York, NY

Client: Copper Development Association, Inc

Sue conducted a significant amount of research in the scientific literature to identify and report on diffuse sources of copper in the environment of the United States. A monograph was prepared for publication by the Copper Development Association detailing copper uses, mining and manufacturing practices, anthropogenic releases, natural occurrence in water, air, soil, sediment, occurrence in a variety of commonly used materials, including fertilizers, roofing material, pesticides/herbicides/biocides, tires, scrap metal, and paints. Approaches to modeling runoff concentrations were

also discussed. Results of the analysis were published in a 2003 Monograph titled, "Diffuse Sources of Copper in the Environment of the United States."

Duwamish River/Elliott Bay Water Quality Assessment – King County, WA

Client: King County

To assist in the evaluation of the CSO standard, Sue managed the assessment of the human health risks in the Duwamish Estuary was performed so that the County's contribution to the risks from CSOs could be defined. As part of the human health assessment, Sue designed and managed the conduct of a fish consumption survey which provided critical information on resource use in the Duwamish River and Elliott Bay for the baseline human health risk assessment. Results of the risk assessment indicated that CSO controls were likely unnecessary, meaning a potential savings of over \$300 million to the County.

Ecological & Human Health Risk Assessments of Sewage Treatment Plants & Sewer – Sydney, Australia

Client: Australian Water Technologies

Sue conducted a screening level human health risk assessment associated with 18 different sewage and storm water discharge alternatives. Exposure pathways of concern included swimming and fish ingestion. Chemicals of concern included volatile organics, metals, phenolic compounds, ammonia, petroleum, and polycyclic aromatic hydrocarbons. Pathogen exposures were also quantified based on a selected indicator species. Results were used to conduct a detailed risk evaluation of wastewater treatment alternatives.

US EPA R-10 Architect and Engineering Services – Various, ID

Client: Environmental Protection Agency

Expert Toxicology and Risk Assessment Support, Portland Harbor Superfund Site – Sue supported EPA Region 10 in their oversight of Responsible Party investigation and risk assessment activities at this aquatic Superfund Site. Sue conducted detailed literature searches and reviews of mammalian toxicity data for PCBs and dioxins to identify critical toxicity studies and critical effect endpoints as part of the development of Toxicity Reference Values for use in the Ecological Risk Assessment. Studies reviewed were carefully critiqued and scientific shortcomings identified to support critical toxicity study selection. Results are being used by EPA in their negotiations with the PRPs. Expert Toxicology and Risk Assessment Support, East Waterway, Puget Sound – Sue provided expert peer review services to EPA on the Remedial Investigation and Feasibility Study being conducted by the Responsible Parties. Reviews of critical toxicology studies underlying Toxicity Reference Values and review of human health toxicity data will be a critical part of this review. Sue also provided peer review of the proposed sampling design to ensure that the number and types of samples collected will support the risk assessment process. Expert Toxicology and Risk Assessment Support, Ketchikan Pulp and Paper Site, Alaska – Sue supported EPA Region 10 in their review of the Remedial Investigation and Feasibility Study conducted at this Alaskan aquatic Superfund Site. Sue reviewed the contractor's baseline risk assessment for human and ecological receptors. Scientific validity of selected dose-response data for ecological receptors and reviewing selected human health toxicity reference values was the key to this review. Conducting a thorough review of the scientific toxicology literature chemical specific published since the risk assessment was conducted will be a key part of the review to determine if toxicity reference values ecological or reference doses/slope factors human health require updating. Dioxins furans and other organic constituents are key constituents of concern. Results will be used by EPA in their negotiations with the PRPs.

Expert Witness – Boulder, CO*Client: Bradley, Campbell, Carney & Madsen*

Sue was retained by the legal firm of Bradley, Campbell, Carney & Madsen to represent their client in litigation over falsified laboratory data. She managed the development of a comprehensive database of the Laboratory's data pre- and post manipulation and used this data in a screening-level risk assessment SLRA. The purpose of the SLRA was to quantify the direction of change in the manipulated data and to make a determination whether the magnitude of the change would have resulted in concentrations that would exceed national or state risk-based standards or criteria. Media evaluated included air, sediment, surface water, groundwater and soil. Results indicated that though data manipulation had occurred, the degree of manipulation which was intended to bring data within client QC limits did not result in an underreporting of concentrations sufficient to exceed health-based human, ecological criteria. The analysis was used to support litigation regarding penalties assessed to the laboratory for damage to human health and the environment.

Fort Lewis Incinerator – Critical Scheduling*Client: Army Corps of Engineers*

Sue assessed the risks to human health posed by projected emissions analogous facility from a 120-ton-per day government operated refuse incinerator at the Fort Lewis Military Base. Evaluated risks for 17 organic dioxins, furans, polynuclear aromatic hydrocarbons, PCBs, volatile organics and inorganic metals, acid gases, oxides of sulfur and nitrogen constituents from direct inhalation. Results were used to obtain a permit for operation of the facility. Risk Assessment of Emissions Associated with the Startup, Shutdown and Potential Upset Conditions of the Fort Lewis Refuse Incinerator – Sue performed a risk assessment for a variety of conditions startup, shutdown, upset conditions associated with the operation of a military refuse incinerator located at the Army's Fort Lewis Military Base. Evaluated inhalation risks for a number of organic polynuclear aromatic hydrocarbons, PCBs, dioxins, furans, volatile organics and inorganic acid gases, metals, oxides of sulfur and nitrogen constituents. Results indicated that potential risks were within allowable levels established by the EPA. Risk Assessment of Fly and Bottom Ash Generated – Sue evaluated the potential risks from exposures to fly and bottom ash associated with the operation of a military refuse incinerator. Risks from fugitive ash emissions were evaluated for facility workers, disposal site operators and residents adjacent to the proposed disposal location. Ash constituents included organic chlorinated benzenes, phenols, dioxins, furans, polynuclear aromatic hydrocarbons and inorganic metal constituents.

Fort Lewis Landfill Closure/Post-Closure Plan and O&M Manual – Fort Lewis, WA*Client: Army Corps of Engineers*

Sue conducted a CERCLA-compliant human health risk assessment for several land-use scenarios and approximately 80 chemicals e.g., metals, pesticides, PCBs, volatile organics, polycyclic aromatic hydrocarbons and other synthetic organic compounds present in soils, sediments, surface water, groundwater and air. She also evaluated residual risk posed by the site following selection of the preferred remedial alternatives and remedial action objectives. Sue worked with public relations staff to develop written materials summarizing, in lay terms, the potential risks associated with the site. She also participated in a series of public meetings where the risk assessment was presented and questions by the public were answered. Results were used to support engineering feasibility studies at the site.

Gas Works Park Sediment Expert Services – Seattle, King County, WA

Client: Seattle Law Department

Sue provided assistance to the City of Seattle regarding contamination in Union Bay offshore of the Gas Works Park. Contractor sampling plans were reviewed to assist in determining the adequacy of proposed sampling programs.

Nickel Toxicity, Essentiality and Homeostasis – Durham, NC

Client: NiPERA

Sue provided peer review on the development of a comprehensive hazard assessment document addressing the fate and effects of nickel in wildlife.

Hong Kong On-Call

Client: Montgomery Watson Harza

Sue conducted a human health risk assessment for Hong Kong's Environmental Impact Assessment of the Strategic Sewage Disposal Scheme. The study objective was to assist the Hong Kong Environmental Protection Department EPD decide the level of sewage treatment required and the optimum outfall location/configuration for disposal of Hong Kong's municipal and industrial effluent. Potential risks from chemical exposures to the general population, including adults and children, were assessed for recreational exposure water, sediments and fish consumption. Level of treatment was evaluated for effluent discharged from a pilot plant located on Stonecutters Island. Using influent from different municipal and industrial sources, the effectiveness of different treatment technologies was assessed. Optimal outfall location was assessed using near-field and far-field water quality modeling to predict exposure concentrations following effluent discharge from Stonecutters Island, East and West Lamma Channels, and the Lema Channel. Risks for continuous lifetime exposure, and other chronic exposure periods as adult, as child were also assessed.

Site Investigation, Human and Ecological Risk Assessments and Reclamation Activities for the Gay Mine – Pocatello, ID

Client: J.R. Simplot Company

Sue was the assistant project manager leading the site investigation and human health and ecological risk assessments at this former phosphate mine site in northeast Idaho, which are part of an overall Site Investigation / Engineering Evaluation and Cost Analysis SI/EECA being conducted at this historical mine site. Among the metals of concern are selenium, arsenic, manganese, cadmium and chromium. The Gay Mine is located on reservation of the Shoshone Bannock Tribal Nation and includes a series of open former mine pits some with lakes and fed by shallow perched aquifers, from historical mining activities by JR Simplot and FMC. On-site and adjacent lakes, wetlands and rivers were investigated to determine the nature and extent of metal contamination and to determine biotic resources and their uses to support the risk assessments. Particular emphasis was put on evaluating the impacts of metals on Shoshone Bannock cultural resources, a key part of the human health risk assessment. The risk assessment had to address candidate and listed Threatened and Endangered Species. Results of the site investigation and risk assessments will be used in developing the Engineering Evaluation / Cost Analysis EECA and in completing remediation, reclamation and monitoring activities at the closed mine site. Sue also completed a surface water monitoring event at 38 locations on this extensive mine site to provide baseline data on six metals/metalloids including arsenic that will support the risk assessment and implementation of remedial action and reclamation activities at the site.

Human Health and Ecological Risk Assessment for the Hansville Landfill – Kitsap County, WA*Client: Kitsap County/KCSL*

Sue prepared the human and ecological risk assessments supporting the Model Toxics Control Act MTCA Remedial Investigation and Feasibility Study RI/FS for the Hansville Landfill. The landfill, located adjacent to the Port Gamble S'Klallam Tribe Reservation and surrounded by forested land and a series of creeks, has had off-site migration of groundwater contaminated with metals and organic chemicals including vinyl chloride. The groundwater daylight and forms the headwaters of a creek that may potentially be used by the S'Klallam Tribe for recreational or other uses such as salmonid rearing. The site is listed on the MTCA Contaminated Sites List. Groundwater is not currently used for potable purposes nor is this use expected in the future. Risk from exposure to landfill gas which had also migrated off-site was also initially of concern. The risk assessment addressed numerous groundwater and surface water exposure pathways and was conducted in accordance with both MTCA and EPA Superfund risk guidelines. The results of the risk assessment indicate that landfill gas does not pose a health concern and some levels of metals and organics in the groundwater could be of concern to public health should the groundwater be consumed. Levels of chemicals in the creeks were not shown to pose risk to people using the creeks. Risks to the health of aquatic life and wildlife using the creeks were shown to be negligible.

Strategic Sewage Disposal Scheme Environmental Impact/Risk Assessment – Hong Kong*Client: Australian Water Technologies*

Sue conducted a human health risk assessment for Hong Kong's Environmental Impact Assessment of the Strategic Sewage Disposal Scheme. The study objective was to assist the Hong Kong Environmental Protection Department EPD decide the level of sewage treatment required and the optimum outfall location/configuration for disposal of Hong Kong's municipal and industrial effluent. Potential risks from chemical exposures to the general population, including adults and children, were assessed for recreational exposure water, sediments and fish consumption. Level of treatment was evaluated for effluent discharged from a pilot plant located on Stonecutters Island. Using influent from different municipal and industrial sources, the effectiveness of different treatment technologies was assessed. Optimal outfall location was assessed using near-field and far-field water quality modeling to predict exposure concentrations following effluent discharge from Stonecutters Island, East and West Lama Channels, and the Lema Channel. Risks for continuous lifetime exposure, and other chronic exposure periods as adult, as child were also assessed.

Critical Review of Toxicological Studies – Bellevue, WA*Client: NiPERA*

Sue provided technical peer review support to an international consortium of nickel producers in support of a European risk assessment of several nickel compounds. Services include conducting comprehensive literature searches of health and safety data, including worker and consumer exposure; nickel compound toxicokinetics, metabolism and excretion. Other studies including irritation, sensitization, carcinogenicity, acute mortality, sub-chronic toxicity, reproductive, fertility, genetic, and developmental toxicity were also compiled and critically reviewed. The project also involves providing critical review of other miscellaneous laboratory and field studies identified through literature searches. Data quality, determining the adequacy of critical toxicological studies and maintaining IUCLID databases were key elements of the project. The quality and nature of the underlying toxicological data were used to assess the accuracy of the European risk assessment.

Laurence-David Risk Assessment – Eugene, OR

Client: Hahn & Associates, Inc.

Sue directed the conduct of a baseline human health risk assessment to evaluate the exposure and risk potential to workers and off-site residents from a variety of contaminants metals, organics in on-site soil, on-site ground water and groundwater that was migrating off-site in the vicinity of a residential area. The risk evaluation was conducted in accordance with State of Oregon Cleanup Guidance. Analyses included evaluation of a number of long-term and shorter-term exposure scenarios for workers as well as long-term exposure to off-site residents to contaminants in the migrating groundwater. Exposure pathways included standard groundwater and soil contact pathways as well as evaluation of indoor and outdoor inhalation exposure to a variety of volatile chemicals in groundwater. The indoor air vapor exposure evaluations were conducted using the EPA's Johnson-Ettinger Model. Results will be used in completing a Feasibility Study and in determining the need for cleanup actions at the site.

**Leviathan Mine Site Natural Resource Damage Assessment, Arco
Environmental Remediation Limited – Alpine County, CA**

Client: Davis, Graham & Stubbs LLP

Sue assisted Arco Environmental Remediation Limited AERL and their legal counsel in addressing Natural Resource Damage NRD claims at the Leviathan Mine Superfund Site in Alpine County, California. The Leviathan Mine discharges acidic mine drainage to Leviathan Creek and Bryant Creek, which in turn may be impacting natural resources, including fish, culturally significant plants, and animals used by the Washoe Tribal Nation. A site reconnaissance effort was recently completed to oversee riparian vegetation and other abiotic media sampling being conducted by Natural Resource Trustees. Sue will continue to provide technical and risk assessment support to AERL as the NRD action by the Federal Trustees develops.

Mill Site Closure and Cleanup – Kitsap County, WA

Client: Pope & Talbot, Inc.

Sue conducted an assessment of the potential for ecological and human health risks associated with contaminated soils and sediments at this former mill site. The investigation and risk evaluation activities were conducted in accordance with the State of Washington's Model Toxics Control Act (MTCA), which provide specific procedures for investigating, evaluating chemical fate and transport, and establishing risk-based cleanup levels at State hazardous waste sites. Chemical data on soil, sediment and tissue concentrations were evaluated using the MTCA framework. Contaminants have entered offshore sediments from historical landfilling activities in the upland portions of the site as well as from historical wood waste resulting from onsite timber storage. Contaminants of concern included PAHs, PCBs, metals and dibenzofurans. A screening level assessment determined a potential risk to seafood consumers that could use the site in the future. Additional data collection was warranted and subsequently fish and shellfish tissue data was collected at the Site and in reference areas to conduct a more definitive risk assessment. Results indicated that consumers were not likely to be at risk under the exposure conditions evaluated. Soil data from the upland landfill sites was evaluated using the risk-based framework for ecological terrestrial receptors and found to pose no risk to the environment. Results are being used to support findings of "No Further Action" at certain operable units at the Site.

Lavaca Bay Superfund Site Sediment RI/FS – Pt. Comfort, TX

Client: Alcoa Remediation Management, Inc.

Problem Formulation for Metal and Organic Chemicals – Sue was the lead author for the preparation of a summary document outlining the general assessment endpoints and food web structure of the estuarine, freshwater, and terrestrial ecosystems at the Alcoa Point Comfort Site as one of the first steps to support a site-specific ecological risk assessment at the Site. Sue also was the lead author on several comprehensive and in-depth problem formulation documents prepared for each of several chemicals of concern at the Site, including: lead, mercury inorganic, organic, cobalt, polycyclic aromatic hydrocarbons and PCBs. The problem formulation documents involved detailed surveys of the scientific literature for each chemical of concern to summarize the state of the science for each of the following in general and specific to the Site: Characterization of Dominant Sources; Environmental Fate in Aquatic and Terrestrial Systems; Environmental Fate Processes Supporting General Assessment Endpoints; Terrestrial and Estuarine Exposure Assessment; Toxic Mechanisms and Dose Response in Terrestrial, Freshwater and Estuarine Systems; Site-Specific Assessment Endpoints; Site Conceptual Models; Candidate Receptors, Testable Hypotheses and Measurement Endpoints; Toxic Reference Values and Scientific Data Gaps. Results were used to support the Site-specific Ecological Risk Assessment conducted at the Site. Sediment RI/FS and Risk Assessment for Mercury: Sue was the project manager and risk assessment task leader for a multi-million dollar, risk-based Sediment RI/FS. Mercury and other organic/inorganic chemicals contaminated sediments was the subject of this investigation in over 60 square miles of estuarine sediments off the shore of Port Lavaca, Texas. Preparation of Work plans, Sampling and Analysis Plans, Quality Assurance Plans, Health and Safety Plans and Project Management Plans according to CERCLA requirements guided the investigations.

Potential risks to both human and ecological receptors are a primary aspect of the investigation. A phased, risk-based approach to the RI/FS was implemented at the site due to the size of the potentially contaminated area, as well as to build on the information gained in each sampling event thereby ensuring efficiency in the site investigation. Investigations were undertaken to assess vertical and lateral extent of contamination in high-risk sediment areas identified through screening-level risk assessments. Site-specific data, including chemical concentrations in sediments, interstitial water, surface water, fish, shellfish and other benthic biota, were collected and evaluated to determine potential risks to human and ecological receptors, and identify potential remedial strategies for site cleanup. Several other studies were also conducted to support the RI and risk assessment, including a radio isotope study examining historical patterns of mercury deposition, a fish and shellfish monitoring study to examine tissue residues over time and a fish tag and release study. Other studies to support the risk assessment and NRDA evaluations included a fish gut content study to examine trophic transfer of mercury in the estuary food chain, a comprehensive study of the prey items utilized by predatory fish and birds in the estuarine ecosystem and a sediment quality triad study. Parametrix also assisted with the preparation of the feasibility study, including conduct of additional field studies.

NTF Marine Outfall Siting Study – King/Snohomish Co., WA

Client: King County

Sue managed the conduct of a recreational and fish consumption survey to support the human health risk assessment conducted to site the Brightwater Treatment Plant proposed for construction by King County. The recreational use survey identified specific uses of beach areas and included interviews to establish frequency of use and other types of activities engaged in at each beach location surveyed. A fish consumption survey conducted simultaneously provided information on fishing use

at the beaches as well as the types of fish caught, the frequency with which self-caught fish are consumed and preparation methods for consumption. Surveys were conducted twice monthly for 12 locations within the project area. The project area spans from Golden Gardens State Park up to Mukilteo in north Puget Sound. Results of the recreational and fish consumption surveys were used to support human health risk assessments associated with facility siting.

Olympic View Sanitary Landfill, Phase I – Bremerton, WA

Client: Olympic View Sanitary Landfill, Inc.

Sue conducted a detailed screening assessment of the potential risks to human health and aquatic life posed by the migration of landfill leachate off-site to adjacent wetlands, the Union River and Hood Canal. Chemicals of concern included volatile organics such as benzene, toluene, ethylbenzene, xylene BTEX, vinyl chloride and several metals. Both EPA Region 10 and MTCA risk assessment procedures were followed in conducting the risk assessment because the MTCA does not address all the potential exposure pathways of concern at the site. Results of the risk assessment were used to determine the need for remedial measures to control leachate at the site.

Lower Ottawa River Sediment Hot Spot Delineation and Ecological Risk Assessment – Ottawa River Area, OH

Client: Limnotech

Sue managed the ecological (aquatic, wildlife) risk assessment for a 9-mile segment of the Lower Ottawa River. This is an urban river flowing through the City of Toledo. The river has been impacted by Combined Sewer Overflow (CSO) discharges, agricultural runoff, leaching from adjacent landfills, potential input from uncontrolled hazardous waste sites and discharges of local petrochemical and manufacturing facilities. Chemicals of key concern in the risk assessment are PCBs, PAHs, pesticides and numerous metals, including arsenic and mercury. Risks to key aquatic and wildlife receptors were evaluated including the contribution of the dietary exposure pathway for persistent bioaccumulative chemicals through a food chain analysis. Acute and chronic risks to wildlife and aquatic life were evaluated. The risk assessment utilized data collected by Ohio EPA and others from 1998 to the present including sediment chemistry, water quality data, tissue residue levels in fish and macroinvertebrates, macroinvertebrate community densities, aquatic bioassay data and other biological criteria. The goal of the screening-level risk assessment was to identify chemicals of potential concern (COPCs) and prioritize locations for remediation or further risk evaluation.

Preliminary Risk Appraisal of Treated Wastewater Reuse/Disposal Options

Client: South East Water Ltd

Sue conducted a preliminary assessment of risk to human health and ecological receptors terrestrial animals, aquatic life. Risks were evaluated for both chemical and microbiological constituents. Results indicated limited, manageable risks from the reuse of treated wastewater. The risks were primarily due to infection from acute exposure to microbiological pathogens, and from toxicity due to long-term accumulation of chemical constituents in irrigated soils. One of the exposure pathways of greatest concern was the inhalation of irrigation spray aerosols. Risks were low and considered manageable with proper management of the irrigation process.

**Puget Sound Region Hatchery Resource Management Plan NEPA EIS –
Puget Sound, WA**

Client: Northwest Indian Fisheries Commission

Sue prepared an analysis of potential impacts to human health and the environment from the use of chemicals used in the management of hatcheries in the northwest. A review of all chemical data provided by the hatcheries was reviewed and supplementary literature searches conducted as needed. Results supported the EIS prepared for NMFS and the Northwest Indian Fisheries Commission.

Hazard Assessment of Boron – Kirkland, WA

Client: U.S. Borax

Sue prepared an ecological hazard assessment summarizing the fate and effects of boron on aquatic life benthic, pelagic and terrestrial microbes, plants, mammals, and bird's receptors. Company-sponsored toxicity studies was supplied by U.S. Borax as part of a thorough compilation of available data on the fate and effects of boron on environmental receptors. Comprehensive literature searches of the peer-reviewed scientific literature, study compilations, reviews and quality ratings were conducted. Results were used to support the development of the hazard assessment report and prepare robust study summaries to supplement the existing IUCLID database for boron. An electronic database containing all literature reviewed with assigned ratings was also prepared. The hazard assessment identified data gaps and provided recommendations on additional studies that would strengthen the existing information on the potential ecological toxicity of boron.

**Human and Ecological Risk Assessments to Support Copper Mine Expansion
– Irian Jaya, Indonesia**

Client: PT Freeport Indonesia Co.

Sue managed the design and conduct of an exposure survey of indigenous and other peoples living in settlements in Irian Jaya, Indonesia that are near tailings-containing rivers and surface impoundments. The exposure survey was designed to provide key site-specific use recreational, subsistence and consumption data for assessing the potential health risks of tailings-exposed villagers. The exposure survey examined the dietary habits of the potentially affected villages, provided data on measured metal concentrations in common food items, drinking water and bathing/recreational waters, and assessed exposure through questionnaires and direct observation those activities that bring villagers into direct contact with tailings in soils and sediment. Consumption rates were determined through the direct measurement of each type of food or beverage consumed by selected village participants i.e., three age groups--- young child, adolescent, adult over a 7-day period. A biomonitoring program was also conducted at the seven villages to concomitantly measure metal exposure of villagers through collection and analysis of hair, blood and urine samples from the 160 survey participants. The results of the exposure survey and biomonitoring program were compared with results of the data collected at three additional control villages to establish baseline exposure conditions for the villages of the region. All results were used to support the Human Health Risk Assessment of current and future mine conditions.

Sewer Overflow Risk Assessment, Georges River – Sydney, Australia

Client: Australian Water Technologies

Sue conducted risk assessments for human health that were used by the Sydney Water Board in the strategic management of sewer overflows and sewage treatment plant STP discharges in a number of urban watersheds. The risk assessments focused on wet weather events when the STP capacities were exceeded, the sewerage system overwhelmed, and stormwater contributed increased loadings of

chemical and other stressors to the receiving waterbodies. The assessments considered risks to human health from acute exposures during wet weather events, and from long-term chronic exposure from the buildup of chemicals in fish caught and consumed by anglers. Chemicals measured in sewer overflow, stormwater, and sediment were initially assessed using screening-level risk assessments. Chemicals of concern from the screening assessments were further evaluated in receiving water with a detailed risk assessment. Receiving water quality was modeled under both dry and wet weather events using a 2-dimensional hydrodynamic model. Stormwater contributions to health risk were evaluated in combination with, and separately from, STP discharges and sewer overflows. A unique aspect of these risk assessments was the conduct of site-specific surveys on recreational use and fish consumption along the rivers. Results from the surveys were used as input to the human health risk assessment to predict risks from acute and chronic exposures in the rivers.

On-Call Services 2001 – Snohomish County, WA

Client: Snohomish County

Sue prepared an Integrated Pest Management Plan IMP for the management of mosquitoes in surface water basins and structures maintained by the County. The IMP provided detailed procedures for managing mosquito populations in a manner that reduced any impact to health and the environment. As a part of the development of this IMP HSPF modeling was completed to estimate residual chemical and biological control agent concentrations in those surface water basins with hydraulic connections to waters of the State. Concentrations were compared with aquatic toxicity thresholds to identify any potential impact to aquatic life.

Southwest Harbor Cleanup and Redevelopment Project – Seattle, WA

Client: Port of Seattle

Sue conducted an assessment of potential risk from metals and organic constituents in Southwest Harbor sediments as part of the evaluation of remedial alternatives for sediment cleanup. Risks were evaluated consistent with the risk assessment procedures in the Washington State Model Toxics Control Act. Risks from fish consumption and from recreational contact with water and sediments were evaluated for current and future conditions at the site. Results also supported an Environmental Impact Statement prepared for the Southwest Harbor site.

Stabilizer Task Force Support – Tarrytown, NY

Client: ORTEP Association

Sue provided technical support to the Stabilizer Task Force (STF) for submission of a screening information data set (SIDs) of information to the OECD's High Production Volume (HPV) data call in program. The STF is a consortium of 12 organotin producers who are sponsoring 28 organotin stabilizer and precursor compounds through the International Council of Chemical Associations (ICCA) HPV Chemical Initiative. The available literature was reviewed on physical/chemical properties, environmental fate, ecotoxicity, and mammalian/human health effects for all the chemicals, and entered appropriate data into the IUCLID database system. Tests were placed with contract laboratories to fill in data gaps. Structure-activity relationships and chemical categories were developed to reduce the need for testings. Test Plans, SIARs, and chemical dossiers were all prepared for submission to the client and regulatory authorities.

Sydney Water-Risk Calculations – Sydney, Australia

Client: Sydney Water Corporation Ltd.

Sue developed methods for assessing risk to human health and ecological receptors. The guidance document, now accepted by the New South Wales EPA, is the first of its kind in Australia and combines current U.S. risk assessment methodologies with Australian/New Zealand/World Health Organization standards and criteria. This guidance document has formed the basis for several risk assessments for human and ecological health performed to support Combined Sewer Overflow projects, wastewater treatment and wastewater reuse projects in the Sydney area.

SWAMP Water Quality Assessment – King County, WA

Client: King County Solid Waste Division

Sue managed the conduct of a Human Resource Use Survey for the SWAMP project. Surveys will play an important role in providing site-specific information to reduce uncertainties in the assessment of risk to human health in the SWAMP Water Quality Assessment WQA. The surveys were designed to estimate exposure potential of people to differing risk factors in the SWAMP study area. For example, the survey asked questions to elicit to what degree people are exposed to reclaimed water used in irrigation or to toxic cyanobacteria blooms in Lake Sammamish during recreational activities. The survey included an initial collection of information from on-line data bases to establish current state of knowledge followed by surveys administered to people using Lake Sammamish. Information from the survey includes the types of activities that bring people into contact with lake and river water, sediments, and biota; the frequency of these activities, and the rates of people consuming fish and invertebrates e.g., crayfish from this watershed.

SMC Site RI/FS – Vancouver, WA

Client: Port of Vancouver

Sue conducted a risk assessment to evaluate the potential risks to site workers at the Port's property and to off-site residents in the vicinity from contaminants Trichloroethylene, perchloroethylene, metals present in groundwater. Measured and modeled concentrations in groundwater and air were compared with risk-based cleanup levels provided in the Washington State Model Toxics Control Act MTCA. Risk apportionment and pathway evaluations were all conducted consistent with MTCA. Modeling of vapor concentrations in enclosed spaces was a key part of the risk assessment given the volatile nature of some of the contaminants. Results of the assessment are being used to support on-going litigation activities.

Tacoma Landfill Groundwater VOC Risk Assessment – Tacoma, WA

Client: Smith, Alling, Lane

Sue managed the development of a risk assessment to assess the risk from volatile organics in groundwater that had migrated off-site of the Tacoma Landfill. The assessment evaluated risks to future residents from soil and groundwater exposure pathways should a residential complex be built on the affected property. Inhalation of volatiles in enclosed building spaces was a pathway of particular concern at the site. Risks from contact of people and aquatic life with affected surface water in a nearby creek were also examined. Results were used to support legal action brought against the City of Tacoma.

Twin Creeks Mine Risk Assessment – Golconda, NV

Client: Newmont Gold Company

Sue conducted a prospective human health risk assessment of the potential for human health risks associated with a pit lake formed following cessation of mining activities at the site. Two alternative pit configurations were investigated as well as three future configuration scenarios. Potential risks to human health from exposure to modeled metal concentrations were estimated for each configuration scenario. Metals included arsenic, copper, silver and mercury. Results of the risk assessment were used in deciding between various pit configurations and identifying risk management actions that reduced or eliminated risks to human health.

Organotin Spill Litigation Support – Columbia, SC

Client: Nexsen Pruet Jacobs & Pollard LLP

Sue managed the investigation of a large organotin spill into an aquatic system in South Carolina on behalf of a confidential client. Sue was retained by the client's legal firm to lead an investigation of the levels of organotin compounds present in the sediment, sediment porewater, surface water, fish and invertebrates of a large creek and lake system. A detailed workplan for the investigation was developed and submitted to the regulatory agencies Department of Health and Environmental Control, DHEC, South Carolina Department of Natural Resources for approval. Data collected will support a human health and ecological aquatic life, wildlife risk assessment. Additional data collection will support the development of a feasibility study, including a treatability study that will evaluate cleanup options for the spilled material. Sue has also been retained to serve as an expert witness in support of ongoing litigation related to the spill.

TBT LTMP and Its Primary Degradation Intermediates – Nationwide, NJ

Client: Arkema Inc.

Sue provided mammalian toxicology support to the Consortium on issues related to human health risk associated with tributyltin TBT and other butyltin monobutyltin, MBT; dibutyltin, DBT; tetrabutyltin, TTBT exposure. Support included the development of multiple "issue papers" that evaluate and discuss the state of the science underlying butyltin mammalian toxicity and its relation to human health exposure and risk. Detailed evaluations Sue completed included assessments of butyltin compound exposures from foodstuff, household products dishes, diapers, shirts, etc., drinking water e.g., leaching from PVC piping, flooring materials and other beverages such as fruit juices and wines. She published technical rebuttals to published scientific studies, raising questions on the relevance of some scientific data to furthering an understanding of potential butyltin impacts to human health. Sue also provided technical support to the TBT Consortium on issues related to the potential toxicity of TBT and its degradation products MBT, DBT to human health and the environment. She published rebuttals in the scientific literature on poor or flawed evaluations of butyltin toxicity to humans, and developed several issue papers on this subject. Issues of concern to the TBT Consortium have included the potential carcinogenicity of butyltin compounds, effects of butyltin compounds on human fertility, endocrine-disruption, health risk to workers manufacturing butyltin compounds, suppression of immune function in people and potential for human health risks from ingestion of butyltin compounds in seafood. She also prepared an evaluation rebutting the potential risks to the general Polish population consuming seafood containing butyltins, as postulated by a United States University Researcher. The evaluation included a comparative risk assessment using data from a United States Market Basket Survey and the latest dose-response data for tributyltin. Conservative assumptions and critical uncertainties in the original risk analysis were

highlighted and their influence on the predicted risks quantified. Results are to be published in an upcoming issue of Marine Pollution Bulletin.

Tin and Organics Air Monitoring – Reno, NV

Client: Cantex, Inc.

Sue managed an air monitoring job for a manufacturer of polyvinyl chloride PVC piping in Reno, Nevada. Concerns were raised that workers were being exposed to potentially adverse levels of tin compounds as well as other organic compounds vinyl chloride, dioxin. Parametrix partnered with a local industrial hygiene firm to conduct the monitoring at the facility. Several locations corresponding to different manufacturing elements were sampled. A short report documenting the methods and sampling results indicate that levels of tin and other organic substances were either not detected or below regulatory standards: Occupational Health Safety Administration, OSHA; National Institute for Occupational Safety and Health, NIOSH.

Assessment of Risks Posed to Aquatic Life Downstream from Irrigation Canals – Eastern Washington, WA

Client: Washington St Water Resources Assoc

Sue managed the conduct of a human health risk assessment of xylene-based herbicides used in irrigation canals in eastern Washington. Concentrations measured at the site were compared with worker protection air standards and air concentrations protective of the general public. Results indicated that concentrations were generally within allowable limits though recreational use of the canals could involve some risk.

Human Health Risk Assessment of Aquatic Herbicides – Seattle, WA

Client: King County

While with another firm, Sue performed a risk assessment for three aquatic herbicides (2,4-D, Endothall, Fluridone) under consideration for use in aquatic weed control. She performed literature surveys to identify toxicological and environmental fate information and evaluated potential risks to human health through five exposure routes. Sue also examined the degradation of the herbicides over time.

Human Health Risk Assessment for Harbor Island – Seattle, WA

Client: Environmental Protection Agency

While with another firm, Sue quantitatively assessed human health impacts associated with over 50 chemicals which included metals (particularly lead), polycyclic aromatic hydrocarbons, PCBs and a variety of synthetic organic chemicals in a screening level risk assessment. Risks were established for several land-use scenarios in close coordination with regional EPA staff. Results were used as input for selecting chemicals to be evaluated in the baseline public health risk assessment for this site.

Human Health Screening-Level Assessment for Occupational Exposure to Wastewater – Seattle, WA

Client: King County

While with another firm, Sue helped with a preliminary evaluation that was conducted to assess risks to workers from exposure to chemicals in wastewater and wastewater air emissions in Metro's wastewater collection and treatment systems. Generic and site-specific data were used to evaluate potential risks and identify chemicals of potential concern to Metro workers. Both acute and chronic exposure scenarios were examined. At the Renton Sewage Treatment Plant chemicals of concern were not identified for any scenario based on acute exposures, though three

chemicals were identified based on chronic worker exposures to air emissions. No chemicals were identified as being of concern in air at the pump stations or in vented manholes based on acute exposures. However, a few chemicals were identified as being of concern for chronic worker exposures to air emissions at the pump station and in vented manholes. These chemicals were largely volatile organics such as benzene, chloroform, methylene chloride, tetrachloroethane and vinyl chloride.

Human Health Risk Assessment for Former Waste Disposal Site – Kenai, AK

Client: Marathon Oil Company

While with another firm, Sue evaluated health risks quantitatively to the residents immediately adjacent to a former waste (liquid, solid) disposal area. She quantified health risks and developed risk-based cleanup criteria for chemicals in soil and groundwater at the site. Chemicals consisted metals, volatile organics, polynuclear aromatic hydrocarbons and PCBs. Sue also wrote a key public summary of the risk assessment results for dissemination to the residents in the immediate vicinity of the site. Results were used to remediate site chemical concentrations to levels which did not pose a health risk to the surrounding community.

Human Health and Ecological Risk Assessment for Colbert Municipal Landfill – Spokane, WA

Client: WA Department of Ecology

While with another firm, Sue performed a quantitative risk assessment for humans and domestic animals exposed to chemicals, primarily volatile organics, leaking into groundwater from this former municipal landfill. Risks were quantified using probabilistic models and uncertainty analysis techniques, and used to support engineering feasibility studies.

Arsenic Acid Residue Monitoring Study in Avian Species – Lubbock, TX

Client: Pennwalt Corporation

While with another firm, Sue managed the conduct of an avian residue monitoring study for a chemical company under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) in support of the re-registration of arsenic acid, a cotton desiccant. She prepared a technical protocol outlining the study design and coordinated all technical and logistical aspects of the field study. She assessed the fate and effects of arsenic acid on and in key avian species and their food items, and site soils. Sue also summarized results in a detailed technical report which was submitted to the EPA in support of the re-registration process for this chemical.

Derivation of Allowable Cyanide Concentrations – Salt Lake City, UT

Client: Kennecott Utah Copper

While with another firm, Sue developed risk-based concentrations of cyanide that would be protective of recreationally exposed populations (children, adults) in an undefined area of Papua New Guinea. Lacking site-specific exposure information, default exposure parameters derived by the United States Environmental Protection Agency were used to establish risk-based water concentrations for acute, subchronic and chronic exposure scenarios for recreational users.

Human Health Risk Assessment of Emissions – Fort Lewis, WA

Client: Army Corps of Engineers

While with another firm, Sue performed a risk assessment for a variety of conditions (startup, shutdown, upset conditions) associated with the operation of a military refuse incinerator located at the Army's Fort Lewis Military Base. Evaluated inhalation risks for a number of organic (polynuclear aromatic hydrocarbons, PCBs, dioxins, furans, volatile organics) and inorganic (acid gases, metals, oxides of sulfur

and nitrogen) constituents. Results indicated that potential risks were within allowable levels established by the EPA.

Human Health Risk Assessment of Fly and Bottom Ash – WA

Client: Army Corps of Engineers

While with another firm, Sue evaluated the potential risks from exposures to fly and bottom ash associated with the operation of a military refuse incinerator. Risks from fugitive ash emissions were evaluated for facility workers, disposal site operators and residents adjacent to the proposed disposal location. Ash constituents included organic (chlorinated benzenes, phenols, dioxins, furans, polynuclear aromatic hydrocarbons) and inorganic (metal) constituents.

Human Health Risk Assessment of Former Landfill Site at McChord Air Force – Tacoma, WA

Client: Army Corps of Engineers

While with another firm, Sue conducted a CERCLA-compliant human health risk assessment for several land-use scenarios and approximately 80 chemicals (e.g., metals, pesticides, PCBs, volatile organics, polycyclic aromatic hydrocarbons and other synthetic organic compounds) present in soils, sediments, surface water, groundwater and air. She evaluated residual risk posed by the site following selection of the preferred remedial alternatives and remedial action objectives. Sue also worked with public relations staff to develop written materials summarizing, in lay terms, the potential risks associated with the site. Participated in a series of public meetings where the risk assessment was presented and questions by the public were answered. Results were used to support engineering feasibility studies at the site.

Fate and Transport Modeling: Simazine and Atrazine Leaching to Groundwater – CA

Client: CIBA-Geigy Corporation

While with another firm, Sue conducted an herbicide fate and transport study for the chemicals simazine and atrazine. She assessed the potential for these herbicides to leach into groundwater using the EPA Pesticide Root Zone Model. Sue also examined the change in leaching behavior with varying partitioning coefficients, hydrolysis and soil metabolism rates.

Rocky Mountain Arsenal Superfund Site: Exposure and Toxicity Assessments – Denver, CO

Client: Army Corps of Engineers

While with another firm, Sue managed and conducted the CERCLA-compliant human health exposure assessment performed as part of the CERCLA RI/FS for the Rocky Mountain Arsenal. The exposure assessment resulted in the selection of 64 target chemicals from over 650 chemicals potentially present in environmental media at the site. A toxicity assessment involving the development of detailed toxicology profiles was prepared by Sue for each target chemical. Development of the toxicity profiles involved extensive literature surveys on physical-chemical properties, environmental fate, metabolism, mammalian and human toxicity studies, including the identification of critical toxicity studies for dose-response assessment for those chemicals lacking EPA Reference Doses. Sue also managed the development of a computer program for performing a screening risk assessment for each of 178 separate sites. Results were used to identify chemicals of potential concern for more detailed evaluation in the probabilistic risk characterization.

Rocky Mountain Arsenal Risk Characterization – Denver, CO

Client: Army Corps of Engineers

While with another firm, Sue managed a CERCLA-compliant quantitative probabilistic risk characterization performed as part of the CERCLA RI/FS at the Rocky Mountain Arsenal. She evaluated human health risks for five land-use scenarios, five soil exposure pathways, 178 sites, and 28 chemicals of concern using probabilistic models and quantitative uncertainty analysis, and, developed probability distributions for each of over 50 chemical, land-use, or age-specific exposure parameters. Chemicals of concern include pesticides, herbicides, military agents (e.g., mustard, Sarin), volatile and semi-volatile organics and metals. Development of exposure parameter and chemical-specific distributions involved extensive literature surveys and incorporation of site-specific information. Sue also served as Army liaison with state and federal agencies and other potentially responsible parties on technical advisory subcommittees responsible for oversight of endangerment assessment activities.

Interim Action Risk Assessments at Rocky Mountain Arsenal – Denver, CO

Client: Army Corps of Engineers

While with another firm, Sue managed the quantitative human health and ecological risk assessments conducted for several Interim Response Actions at the Arsenal. Assessments addressed predominantly vapor and particulate inhalation exposures associated with interim remedial measures for a number of localized areas of high chemical concentrations. Sue also evaluated risks for workers, nearby residents and biota. Results were used to mitigate chemical release during remedial activities.

Human Health Risk Assessment for McChord Air Force Base Washrack Treatment Area – Tacoma, WA

Client: Martin Marietta Energy Systems

While with another firm, Sue managed the CERCLA human health risk assessment which studied over 60 chemicals (volatile organics, polycyclic aromatic hydrocarbons, metals) measured in soils, sediments, surface water, and groundwater for several land-use scenarios. Results were used to support engineering feasibility studies at the site.

Human Health Risk Assessment and RCRA Closure – Pompano Beach, FL

Client: Stimpson Company

While with another firm, Sue conducted a RCRA human health risk-based site closure of two surface impoundments used for storage and treatment of metal containing wastes generated from manufacturing operations at the site. She also developed a range of health-risk based cleanup criteria which included considerations of uncertainty. Cleanup criteria were originally established at background levels and the development of health-based cleanup criteria significantly reduced the volume of site soil which would have required remediation under the original cleanup order.

Human Health Risk Assessment of Emissions from Retrofitted Steam Plant – Tacoma, WA

Client: City of Tacoma

While with another firm, Sue conducted a human health risk assessment for inhalation exposures to projected emissions (analogous facility) from the City of Tacoma's incinerator which was operated previously as a steam plant. Exposures and risks were quantified for inhalation exposures to 14 organic (benzene, polycyclic aromatic hydrocarbons, formaldehyde, dioxins, furans) and inorganic (acid gases, oxides of sulfur and nitrogen, metals) constituents. Sue also supported the county

health department's technical staff in communicating the results of the assessment to the public. Results supported the facility permitting process.

Incinerator Risk Assessment Validation Study – Tacoma, WA

Client: City of Tacoma

While with another firm, Sue conducted a follow-up study which assessed inhalation risks from actual facility emissions to permit validation of both projected facility emissions and projected risks. Results indicated that several emissions constituents projected from analogous facility data were not present in the measured emissions and that inhalation risks attributable to emitted chemicals were lower than risks originally projected. Additionally, risk evaluations confirmed that potential risks from other exposure pathways were not as significant as those potentially posed by the inhalation route. Results also supported the operation permit issued to the City.

Human Health Risk Assessment for Former Coal Gasification

Site – Tacoma, WA

Client: Puget Sound Energy

While with another firm, Sue conducted a quantitative risk assessment on behalf of several industries previously occupying the site which had formerly been used as a coal gasification facility. Chemicals consisted chiefly of polynuclear aromatic hydrocarbons, PCBs, metals and volatile organics. She developed human health risk-based cleanup criteria for site soils utilizing probabilistic models and uncertainty analysis. Sue also evaluated risks to ecological receptors (primarily avian species) present at the site. Results were used as input to the engineering feasibility study undertaken at the site.

Human Health Risk Assessment of Emissions from Fort Lewis

Incinerator – WA

Client: Army Corps of Engineers

While with another firm, Sue assessed the risks to human health posed by projected emissions (analogous facility) from a 120-ton-per day government operated refuse incinerator at the Fort Lewis Military Base. She also evaluated risks for 17 organic (dioxins, furans, polynuclear aromatic hydrocarbons, PCBs, volatile organics) and inorganic (metals, acid gases, oxides of sulfur and nitrogen) constituents from direct inhalation. Results were used to obtain a permit for operation of the facility.

Toxicity and Carcinogenicity Studies for Pesticide Registration – Bryan, TX

Client: Pennwalt Corporation

While with another firm, Sue managed the performance of acute toxicity (ocular, dermal, oral), reproductive toxicity, and carcinogenicity studies for two pesticide formulations (Mancozeb, Topsin) on behalf of a large chemical company. This involved selection of qualified laboratories, study protocol review, monitoring of study progress, and technical review of reports documenting study results.

Field Dissipation Study in Support of New Chemical Registration – Mansfield, WA

Client: CIBA-Geigy Corporation

While with another firm, Sue conducted a field dissipation study under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) to support new chemical registration. Sue also researched and wrote technical protocol for conducting the study using a new insecticidal formulation designed for use on apple crops. Study involved test material application and soil residue monitoring through periodic soil collection and analysis.

Sediment Criteria Development Methodology for Ecological Protection – Washington, DC

Client: Environmental Protection Agency

While with another firm, Sue assisted in the continuing development of a methodology which involved the use of equilibrium partitioning to predict contaminant movement throughout aquatic and terrestrial food chains in the establishment of health-based sediment quality criteria for ecological protection. Results were considered by the EPA in establishing a national strategy for developing sediment criteria.

Worker-Right-to-Know Compliance Study – Renton, WA

Client: Valley Medical Center

While with another firm, Sue conducted a facility audit on all hazardous and non-hazardous substances used in the medical center to support the center's compliance with worker-right-to-know requirements. Results of the audit were placed in a comprehensive data base supplied to the client. Material Safety Data Sheets were obtained for all substances where available. Where MSDSs were not available, a summary data sheet on available physical, chemical and toxicological information was prepared.

Fort Lewis Logistics Center Endangerment Assessment – Tacoma, WA

Client: Army Corps of Engineers

While with another firm, Sue was the lead scientist for a CERCLA endangerment assessment of an Army training facility and surrounding grounds. She developed maximum acceptable concentrations of volatile organics and metals for soil, groundwater and surface water. She also quantified risks to human receptors using deterministic models for five soil, four groundwater and two surface water exposure pathways. Results were used to support remedial actions proposed for the site. Sue participated in public meetings which presented and discussed the results of the risk assessment with community members, and assisted in the development of written materials for dissemination to the general public communicating the potential risks at the site.

Rio Tinto Risk Assessment Services – Elko County, NV

Client: Rio Tinto Working Group

Sue is providing technical support on investigation and risk assessment issues to the Rio Tinto Working Group, a consortium of companies with historical involvement at the Rio Tinto Mine Site in Nevada. Underground mining of a rich copper sulfide ore deposit began at the site in 1932 and terminated with the closure of the mine in 1947. During the ensuing years, there were a number of activities undertaken including re-working of the old tailings, leaching stockpiles of ore, leaching the underground workings and exploring for additional mineral deposits. The property has been dormant since the late 1970s. A risk assessment work plan was completed for one of two areas of the mine site that have been impacted by historical releases. Sue prepared a Sampling and Analysis Plan to sample an offsite area downstream of the Mine Site and provide data on metals residues (including background concentrations) in several aquatic and terrestrial media, including: soil, sediment, aquatic and terrestrial invertebrates, aquatic and terrestrial plants, small mammals and surface water. Sue managed the conduct of the field investigation and the preparation of a summary of the findings. Results were used to provide input to a screening level assessment to be used by the Trustees and Agencies in determining what additional work is required to complete remedial activities at the Site.

Great Falls Historical Smelter/Refinery Site Investigation – Atlantic Richfield Company, Black Eagle, Montana

Sue managed on behalf of Atlantic Richfield Company an investigation of the extent of contamination resulting from historical releases of smelter slag to the Missouri River, adjacent to the site of their historical smelter/refinery. Sue prepared a Sampling and Analysis Plan (including Quality Assurance Project Plan and Health and Safety Plan) to guide the collection of sediments, surface water and fish tissue. Fish tissue sampling was coordinated with the Montana Department of Fish, Wildlife and Parks. All site media were analyzed for a suite of metals and the results used in the preparation of a data report and a screening level risk assessment. Results of the screening assessment indicated minimal risk to human or ecological receptors associated with exposure to metal levels in the sediment, surface water and tissues.

Draft Water Quality Regulation Comments – JR Simplot

Sue and others provided extensive technical comments on the EPA's draft Ambient Water Quality Criteria Document for Selenium. Numerous technical areas of concern were identified, summarized and presented in a draft technical memorandum presented to JR Simplot. These comments were provided by JR Simplot to the National Mining Association, who submitted comments by all members to the USEPA.

Lead Ambient Air Quality Criteria Document - OR

Sue provided senior peer review of draft technical sections pertaining to the effects of lead in the aquatic environment prepared by Parametrix and other consultants.

Jemez Canyon Reservoir Drawdown Environmental Studies – Benalillo, NM

Sue reviewed Sampling and Analysis Plans prepared for sampling mercury contaminated sediments that had built up behind the Jemez Canyon Reservoir Dam. Sue also was a senior peer reviewer on the Human Health and Environmental Screening-Level Risk Assessments that were prepared.

Landfill Engineering and Environmental Services 2005 – Port Angeles, WA

Sue was retained by the City's Attorney to assist in defending their interests in litigation concerning Ecology's Model Toxic Control Act. Specifically, the litigation revolved around whether Ecology's MTCA regulation at the time required cleanup for mixtures based on individual compounds in the mixture or for the mixture as a whole. Sue advised the City Attorney on this matter as the litigation proceeded through the judicial system. Ecology's regulation was found to be invalid because public comment on the matter was never sought before the MTCA rule was promulgated.

Lihir Project Review- Papua

Sue and others that had previously prepared an aquatic and wildlife risk assessment downstream of a copper mine were retained to review the project, its goals, and findings to support ongoing litigation associated with the mine's operators.

Derivation of Allowable Cyanide Concentrations – Salt Lake City, UT

Client: Kennecott Corporation

Sue developed risk-based concentrations of cyanide that would be protective of recreationally exposed populations (children, adults) in an undefined area of Papua New Guinea. Lacking site-specific exposure information, default exposure parameters derived by the USEPA were used to establish risk-based water

concentrations for acute, subchronic and chronic exposure scenarios for recreational users.

Makah Whale Hunt NEPA EIS – Neah Bay, WA

Client: NOAA / National Marine Fisheries

Sue prepared key sections of the NEPA EIS that was prepared to support the Makah Indian Nation's application to the National Marine Fisheries to hunt whales for the tribe's personal use. Specifically, Sue prepared the chapters dealing with an analysis of the health benefits and risks from exposure of tribal members to the contaminants present in whale food products.

Human Health Analysis for Puget Sound Hatchery NEPA Review – Puget Sound, WA

Client: NOAA Fisheries

Sue conducted the human health evaluations as part of a NEPA review of an Environmental Impact Statement under preparation for 117 Puget Sound anadromous salmonid hatcheries. The human health section provided a review of the types of chemicals used by hatchery staff (e.g., formalin, pesticides, MS222), disposal of chemical wastes, and the potential for transmission of naturally occurring diseases to people. The review also examined the issue of chemical contaminants in hatchery feed posing a potential risk to people consuming hatchery fish.

Owens & Sons Site Spill Review – Ellensburg, WA

Sue was retained by the law firm of Cone & Gilreath to prepare an expert report on the potential risk to human health that could arise from exposure to soils contaminated with materials from a sewage spill on private property. Findings were used to defend the City of Cle Elum against claims of personal injury and loss of property value as a result of the sewage spill, which had already been cleaned up by the City.

Ecological and Human Health Screening-Level Risk Assessment for Autocausticizing Process – Valencia, CA

Client: Rio Tinto U.S. Borax

Sue conducted an aquatic life, wildlife and human health screening level risk assessments associated with an autocausticizing wood treatment process that utilizes boron. Pond discharge concentrations were evaluated for aquatic and wildlife toxicity and pond sludge was evaluated under several different reuse scenarios. Rio Tinto U.S. Borax used results as part of their Sustainable Development and Product Stewardship programs.

Integrated Pest Management Plan Development – Issaquah, WA

Client: City of Issaquah

Sue conducted a review of pest management practices and a toxicological review of the approved pesticides used for the control of mosquitoes. She successfully worked with the county to write a technical document describing the desired practices for mosquito monitoring and management. Sue also developed toxicological profiles for each pesticide and identified threshold effect levels for non-target receptors. These threshold levels were used in a modeling effort that determined the potential concentration of pesticides in waterways adjacent to the stormwater ponds. This effort led to the selection of specific pesticides that were determined to not have an effect on non-target species. The county received outside review of the Integrated Pest Management Plan and is working on implementing the plan at all of their facilities (stormwater, sumps, etc.) that have linkages to Washington State waterbodies.

SMC Site RI/FS – Vancouver, WA

Client: Port of Vancouver

As part of an RI/FS of a former industrial facility on Port property, Sue managed the preparation of a human health risk assessment of contaminants in groundwater and soil. The assessment was prepared to aid in site cleanup efforts. Initial efforts focused on characterizing the extent of trichloroethylene TCE in soil and groundwater in the vicinity of the Mill Plain Extension Project. Sue managed the preparation of a detailed baseline risk assessment of volatile chemicals in on-site and off-site groundwater and soil gas. This involved extensive fate and transport modeling using the US EPA Johnson & Ettinger vapor transport model for vapor intrusion into buildings.

Screening Level Risk Assessment for Hartland Landfill – Vancouver, B.C.

Client: Society of Toxicology and Chemistry

Sue managed the planning and conduct of a screening-level risk assessment (SLRA) of leachate for the Society of Environmental Toxicology and Chemistry, on behalf of the Capital Regional District (CRD). The SLRA of Hartland leachate was in support of a larger effort undertaken by an expert review panel commissioned by the CRD to provide recommendations on the need for conducting treatment of wastewater passing through the Vancouver, B.C. sewage treatment plant. The SLRA indicated that based on available data, low risks to people and the environment were indicated from the leachate, but also identified several key data gaps that should be filled to address a number of analysis uncertainties.

TOFIX-S Toxic Substances Control Act (TSCA) Registration – Tokyo, Japan

Client: Technobill Co. Ltd.

Sue is currently assisting a Japanese client with their application to the United States Environmental Protection Agency for registration of a titanium compound that would permit import of the substance into the United States for industrial use. Sue is providing overall coordination of the preparation of the Premanufacture Notice (the application). She is also providing the client with support on understanding the implications of the new European REACH regulation and assisting the client in regulatory compliance.

Upper Blackfoot Mine Ecological Risk Technical Support – Anaconda, MT

Client: Atlantic Richfield Company

Sue conducted a detailed review of the Engineering Evaluation / Cost Analysis (EE/CA) prepared by the USDA Forest Service's consultant on behalf of the Atlantic Richfield Company. Sue's review focused on the technical validity and appropriateness of the risk assessments (human health and ecological), which were used to support the suggested remedial action.

Ecological Risk Assessments, Magnesium Mining/Refining Facility

Client: Confidential

Sue is managing the aquatic and wildlife risk assessments at an operating magnesium processing facility in Utah. Working with the client's legal counsel, Sue developed a Sampling and Analysis Plan to collect abiotic and biotic media for use in a comprehensive ecological risk assessment. Soils, sediments, aquatic macroinvertebrates, terrestrial insects, small mammals and forbs/plants were collected and analyzed for a suite of chemicals of concern including: dioxin/furan/PCB congeners, arsenic, barium, cadmium, chromium, lead and selenium. Sue developed a comprehensive ecological risk assessment work plan to guide the risk evaluations conducted with the site data. The risk assessment is close to completion and results will be used to identify remedial actions required to

reduce ecological risk through exposure pathways of concern. As part of the risk assessment, detailed and comprehensive literature searches and critical toxicology studies were identified to support the aquatic and wildlife risk assessments for several organic and metal constituents. Dose-response curves were examined for some chemicals to identify slope and provide an understanding of the margin of safety between effect and no-effect doses. Current activities include evaluating the impacts of metals and organic chemicals on shorebird and songbird reproduction, which will be used to update the draft risk assessment.

Principal Published Works

Ms. Robinson is an author of referred journal publications as well as the principal author of numerous technical reports prepared for industry, public sector clients and legal clients. These publications and technical reports address chemical-specific fate and toxicology, site-specific contaminant investigations as well as human health (worker, residential, recreational) and ecological (plant, wildlife, aquatic life) risk assessment. Specific publications are identified below.

Mayfield, D. B., S. Robinson and J. Simmonds. 2007. Survey of fish consumption patterns of King County (Washington) recreational anglers. *Journal of Exposure Analysis and Environmental Epidemiology*, Volume : 1-9.

Tsujij, J. and S. Robinson. 2001. Separating potential source exposure from background exposure in subsistence populations in developing countries. *Proceedings of the International Congress of Toxicology*. Brisbane, Australia. July 2001.

Robinson, S. and M. Kluck. 2000. Comment on the occurrence of butyltin compounds in human blood. *Environmental Science and Technology*, Volume 34 (9): 1877-1881

Stewen, U., M. Fisch and S. Robinson. 2000. The Consumer Safety of Butyltin Compounds in PVC and CPVC Pipe. Prepared for: Crompton Corporation, Tarrytown, New York. August 2000.

Robinson, S., J. Volosin, J. Keithly and R. Cardwell. 1999. Comment on: Butyltin Residues in Sediment, Fish, Fish-eating Birds, Harbour Porpoise and Human Tissues from the Polish Coast of the Baltic Sea. *Marine Pollution Bulletin* Volume 38 (1):57-61.

Robinson, S., D. MacLellan, L. Tear and K. Gribben. 1998. Triad Evaluation of Mercury Contaminated Sediments in a Shallow Texas Gulf Coast Estuary. Manuscript submitted to *Environmental Toxicology and Chemistry*.

Robinson, S., R. Kadeg and S.P. Pavlou. Applications of risk assessment techniques in RCRA clean closure of surface impoundments with trace metal contamination. In: *Risk assessment/management issues in the environmental planning of mines*. D. Van Zyl, M. Koval and T.M. Li, Editors. Society for Mining, Metallurgy, and Exploration, Inc. Littleton, CO. pp. 171-176.

Robinson, S., R.J. Kendall and R. Robinson. Effects of agricultural spraying of methyl parathion on cholinesterase activity and reproductive success of starlings (*Sturnus vulgaris*). *Environmental Toxicology and Chemistry*, Vol. 7:343-349, 1988.

Invited and Other Presentations:

- Mayfield DB, Robinson S., Simmonds J. 2006. Survey of recreational activities along King County, WA shorelines for use in site-specific risk assessment: Exposure distributions for sediment and water contact activities and fish consumption. Poster Presented at the Annual Meeting of the Society of Toxicology. San Diego, CA. March 7, 2006.
- Robinson, S. and DeForest, D. K. 2005. Uncertainties in Estimating Whole Body Selenium Concentrations in Fish From Other Tissues and Implications for Tissue-Based Criteria. Presentation at the 26th Annual Meeting of the Society of Toxicology and Chemistry, Baltimore, MD. November 15, 2005.
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- Robinson, S. Continuing legal education seminar presented to Davis, Wright, Tremaine: Challenges in Allocating Liability at Natural Resource Damage Assessment Sites. October 2002.
- Robinson, S. and A. Fairbrother. 2001. Human Health Risks from Organotin Compounds in Household Products. A presentation to the Organotin Environmental Programme Organization (ORTEP), Sardinia, Italy. January 2001.
- Robinson, S., D. MacLellan, M. Spency and K. Gribben (ALCOA). 1999. Triad Evaluation of Mercury Contaminated Sediments in a Texas Estuary. Presented at: Fifth International Symposium on In Situ and On-Site Bioremediation. April 19-22, 1999. San Diego, California.
- Robinson, S., D. Hammon, L. Tear (Parametrix, Inc.), Kirk Gribben (Aluminum Company of America). Mercury Accumulation in Fish and Prey Items from a Texas Gulf Coast Estuary. Presentation at the 19th Annual Meeting of the Society of Environmental Toxicology and Chemistry. Charlotte, North Carolina. November 15-19, 1998.
- Cappellino, S., S. Robinson (Parametrix, Inc.), and C. Dobbs (Aluminum Company of America). Risk-Based Investigation of Contaminated Sediments in Lavaca Bay, Texas. Presented at the 1998 Minerals Council of Australia. Melbourne, Australia. October 1998.
- Choy, C., C. Prescott, M. Abrams (City of Portland), S. Robinson and J. Toll (Parametrix, Inc.). Risk-based Investigations of Columbia Slough. Presented at August 1998 Special SETAC Symposium, Seattle, Washington.
- MacLellan, D., S. Robinson, L. Tear (Parametrix, Inc.), D. Harper (Texas A & M University) and K. Gribben (Aluminum Company of America). Benthic macroinvertebrate community structure evaluations in relation to sediment mercury concentrations. Presentation at the 18th Annual Meeting of the Society of Environmental Toxicology and Chemistry. San Francisco, California. November 16-20, 1997.

- Robinson, S., D. MacLellan, L. Tear (Parametrix, Inc.) and K. Gribben (Aluminum Company of America). 1997. Triad Evaluation of Mercury Contaminated Sediments in a Shallow Texas Gulf Coast Estuary. Presentation at the 18th Annual Meeting of the Society of Environmental Toxicology and Chemistry. San Francisco, California. November 16-20, 1997.
- Robinson, S., R. Cardwell (Parametrix, Inc.), C. Choy (City of Portland). Ecological and Health Risk Assessment: A Focusing Tool for Investigation and Remedial Activities in the Columbia River Slough. Presented at the 16th Annual Meeting of the Society of Toxicology and Chemistry. Vancouver, B.C. November 1995.
- D.A. Johnson, K. Cothorn, S. Robinson, E. Dorward-King and S.P. Pavlou. Use of Bayesian estimators to integrate generic and site-specific parameter distributions into the risk assessment model for a hazardous waste site. Presentation at the 13th Annual Meeting of the Society of Toxicology and Chemistry. Cincinnati, Ohio. November 8-12, 1992.
- K. Cothorn, S. Robinson, D. Johnson, E. Dorward-King and S.P. Pavlou. Estimation of confidence intervals with censored environmental data sets. Presentation at the 13th Annual Meeting of the Society of Toxicology and Chemistry. Cincinnati, Ohio. November 8-12, 1992.
- Robinson, S., S.P. Pavlou and R. Kadeg. Risk assessment applications in site closures under RCRA. Presentation at the 1992 meeting of the Society of Mining and Metallurgical Engineers, St. Louis, Missouri. October 5-7, 1992.
- Robinson, S., T. Trenkler, S.P. Pavlou and D. Waite. Survey of guidance on methods for conducting mixed waste assessments. Presentation at the First International Mixed Waste Conference. Baltimore, Maryland. August 21-24, 1991. Paper accepted for publication in special conference proceedings.
- Pavlou, S.P. and S. Robinson. Human health exposure through contaminated sediments. Presentation at the U.S. EPA Workshop on Contaminated Sediments. Narragansett, Rhode Island. May 6-9, 1991.
- Robinson, S., W.E. Maier and S. Tucker. Comparison of health risk assessments for municipal waste combustors: Is evaluation of multiple exposure pathways required? Presentation at the 12th Annual Meeting of the Society of Toxicology and Chemistry. Seattle, Washington. November 3-7, 1991.
- Dorward-King, E.R., Walton, S. Robinson and R. Kadeg. A site-specific risk assessment of storm water discharge into Lake Union, Seattle. Presentation at the 12th Annual Meeting of the Society of Toxicology and Chemistry. Seattle, Washington. November 3-7, 1991.
- Pavlou, S.P., S. Robinson and L. Logan. How clean is clean application of exposure pathway analysis to ecological criteria development. Presentation at the International Specialty Conference on How Clean is Clean? Cleanup Criteria for Contaminated Soil and Groundwater. Boston, Massachusetts. November 6-9, 1990.
- Robinson, S. and S.P. Pavlou. The use of exposure pathway analysis in the development of sediment cleanup goals for ecological protection. Presentation at the 8th International Ocean Disposal Symposium. Dubrovnik, Yugoslavia. October 9-13, 1989.

- Robinson, S. and S.P. Pavlou. The use of exposure pathway analysis in the development of sediment cleanup goals for ecological protection. Presentation at the 1989 International Conference, OCEANS 89, Marine Technology Society and Ocean Engineering Society of the Institute of Electrical and Electronic Engineers. Seattle, Washington. September 18-21, 1989.
- Robinson, S., R. Robinson, C.J. Driver and R.J. Kendall. Effects of agricultural sprays of methyl parathion on reproduction and cholinesterase activity in starlings (*Sturnus vulgaris*) in Skagit Valley, Washington. Presentation at the Sixth Annual Meeting of the Society of Environmental Toxicology and Chemistry, Wildlife Toxicology Symposium. St. Louis, Missouri. November 10-13, 1985.

Joseph S. Volosin

Position in Company:	Environmental Toxicologist
Specialization:	Environmental Toxicology and Risk Assessment
Nationality:	American
Education and Professional Status:	BA, Zoology, 1985 MEM, Environmental Toxicology, 1988
Membership of Professional Bodies:	<ul style="list-style-type: none">• Society of Environmental Toxicology and Chemistry
Key Areas of Expertise:	<ul style="list-style-type: none">• Aquatic and terrestrial toxicology and ecological risk assessment• Environmental monitoring and assessment• Data management and analysis• Environmental statistics and fate and transport modeling
Language Capabilities:	English

Key Professional Experience

Pinal Creek Monitoring Program – Globe, AZ

Client: Pinal Creek Group

Joe is managing and implementing a recovery study for a stream that was affected by metal-rich acid mine drainage. The long-term study includes biological surveys of aquatic macroinvertebrates, chemical monitoring, and an ongoing assessment of the aquatic and riparian habitat recovery.

Chemical and Biological Monitoring – Troy, MT

Client: Asarco, Incorporated

Joe manages the assessment of possible non-point releases of heavy metals from a copper-silver mine for thirteen years. The ongoing evaluations include field studies of aquatic insects to determine if there are significant heavy metal releases associated with the mine. An annual report is prepared and presented to the State of Montana, Department of Health and Environmental Services.

UCR (Upper Columbia River) RI/FS – WA

Client: Teck Cominco American, Inc.

Joe provided technical support for various assessments for this project. Assessments included sediment toxicity, metals in fish, metal distribution in reservoir sediment, estimates of mercury loading to the reservoir, and affects of reservoir management on aquatic life. Lake Roosevelt is an over 100-mile reservoir that has various metals in its sediment.

PTFI ERA – Irian Jaya, Indonesia

Client: P.T. Freeport Indonesia Co.

Joe was the technical lead in the evaluation of aquatic and wildlife risk related to tailings residue in rivers, lakes and an estuary near the site. Metals in the tailing residue is the source of chemical constituents in this evaluation. The risk of effects due to metal exposure from dietary sources are being evaluated for wildlife, direct exposure to metals in the water column and sediment for aquatic life, and that from total suspended solids to aquatic life.

**Leviathan Mine Site Natural Resource Damage Assessment, Arco
Environmental Remediation Limited – Alpine County, CA**

Client: Davis, Graham & Stubbs LLP

Joe supported the biological characterization of this site. The aquatic biological community was characterized in five streams that were potentially affected by the mine. Number of taxa, dominant taxa and habitat conditions were evaluated.

**Risk Assessment, Cleanup Goals and Remediation: Acid Rock Drainage in
Pinal Creek – Globe, AZ**

Client: Hydro Geo Chem, Inc.

Joe managed feasibility studies on the application of wetlands and chemical treatment to remove manganese and other metals from surface water at the site. Metal-rich acid mine drainage is the source of chemical constituents in this evaluation. Studies included an evaluation of a passive wetland treatment system, a chemical/physical treatment system, and a combination of the two systems.

Eagle River – CO

Client: Davis, Graham & Stubbs LLP

Joe managed the evaluation of the impacts of acid mine drainage on the Eagle River. A screening level risk assessment was performed to assess the possible impacts of the toxic components of the acid mine drainage on brown trout in the Eagle River. Continuing studies include the development of biological criteria for the assessment of brown trout populations and macroinvertebrate communities, habitat evaluations, and site-specific toxicity evaluations.

**Literature Review and Water Quality Standard Development for Turbidity –
OR**

Client: Steel River LLP

Joe provided technical assistance in the evaluation of the potential effects of turbidity on aquatic life. A complete scientific literature review was conducted. Data were tabulated for both adverse as well as beneficial effects of turbidity. The data as tabulated can be used for criteria development and risk assessment purposes.

**Great Falls Historic Smelter/Refinery Site Aquatic Investigation – Black
Eagle, MT**

Client: Atlantic Richfield Company

Joe implemented a sampling and analysis plan for the Missouri River near Great Falls, Montana. The field efforts that were implemented included the collection of water, sediment and fish samples. Fish were collected with the support of the Montana Department of Fish and Game. Fish were weighed, lengths measured and appropriate species filleted on site. Metals potentially affect the river; this sample event is to be used in Superfund site ranking.

Rio Tinto Risk Assessment Services – Elko County, NV

Client: Rio Tinto Working Group

Joe served as technical lead in the data collection effort for a wildlife risk assessment related to mining impacts in a river. Metals in tailing residue are the source of chemical constituents in this evaluation. The risks of effects due to metal exposure from dietary sources will be evaluated for wildlife.

Human Health and Wildlife Risk Assessment – Winnemucca, NV

Client: Newmont Gold Company

Joe assisted in the assessment of the risks posed to wildlife from exposure to the water, aquatic life, and plants living in the pit lake created from closure of a gold mine. Arsenic and zinc are the principal metals of concern.

Human and Ecological Risk Assessment – Globe, AZ

Client: Hydro Geo Chem, Inc.

Joe managed the studies on human and ecological risk related to contaminated groundwater and surface water at the site. Metal-rich acid mine drainage is the source of chemical constituents in this evaluation. The risks of effects due to metal exposure from dietary sources were evaluated for humans and wildlife. Other studies included toxicological evaluations.

Brown's Battery Superfund Site – Reading, PA

Client: Exide Corporation

Metals released to the soil and leaching to groundwater from recycled batteries at a site next to the Schuylkill River in Pennsylvania were monitored for occurrence in the River. Joe conducted the chemical and ecological monitoring of potential adverse effects from lead and other heavy metals on river life.

Ecological Risk Assessment – Salt Lake City, UT

Client: Kennecott Utah Copper

Joe provided technical support in the evaluation of risks posed by groundwater entering surface waters and potentially contaminating the aquatic life consumed by various bird species. A variety of metals and metalloids are being evaluated for bioaccumulation, bioavailability, and effects on aquatic life.

Assessment of the Ecological and Human Health Risks Downstream from Copper Mining – Irian Jaya, Indonesia

Client: P.T. Freeport Indonesia Co.

Joe served as technical lead in the evaluation of the fate and effects of copper and total suspended solids on a mangrove community. The fate of copper and total suspended solids was evaluated in the mangrove ecosystem. The source of the copper and total suspended solids was from tailings residue in a river that inundates the mangrove. The aquatic community that was evaluated was dominated by macroinvertebrates.

Support on Environmental Issues – Yakima, WA

Client: Yakima Basin Joint Board

Joe provided technical support in the evaluation of risks posed by herbicides entering surface waters via canals and potentially affecting aquatic life. A variety of herbicides are being evaluated for bioaccumulation, bioavailability, and effects on aquatic life.

Reservoir Drawdown Studies – Southwestern U.S., NM

Client: Pueblo of Santa Ana

CONFIDENTIAL CLIENT: Joe was the technical lead in the evaluation of aquatic life and wildlife risk related to potentially contaminated sediment in a reservoir. The reservoir was to be drained with the subsequent release of sediment to a stream and river. Metals in the sediment are the source of chemical constituents in this evaluation. The risks of effects due to metal exposure from dietary sources are being evaluated for wildlife.

Lower Ottawa River Sediment Hot Spot Delineation and Ecological Risk Assessment – Toledo, OH

Client: Limnotech

Joe supported the ecological screening level risk assessment for this site in Ohio. He specifically used biological communities in the evaluation of potential impact. Biological criteria (IBI) were used for the assessment macroinvertebrate communities as well as evaluating habitat characteristics that affect macroinvertebrate communities (e.g., QHEI).

Metalloregions – New York, NY

Client: International Copper Assoc., Ltd.

Joe supported the evaluation of background levels of copper in European Union country soils. Data analysis included the evaluation of means, medians, percent ranks and statistical differences between habitat types.

SWAMP Water Quality Assessment – Sammamish, WA

Client: King County

Joe supported the preparation of a screening level risk assessment (SLRA) for this site. He prepared the wildlife section of the Problem Formulation for the site and developed the exposure models used at the site and compiled the effects database for wildlife. Chemicals of concern were diverse, including metals, organic chemicals such as PCBs.

Ecological Risk Assessments, Magnesium Processing Facility

Client: Parsons, Behle & Latimer

Joe was involved in various field activities at the US Magnesium site. Field activities included the collection of soil, water, sediment, and biological samples. Biological samples collected were terrestrial insect, brine fly adults and larvae, plants, and mammals. Novel approaches were developed to collect the brine fly larvae and adults. PCBs, dioxins, and metals were the chemicals of concern at the site.

Ambient Water Quality Criteria for Cyanide – Corvallis, OR

Client: Water Environment Research Foundation

New water quality criteria for cyanide were developed for the Water Environment Research Fund. Joe helped develop wildlife criteria for cyanide. These criteria were for wildlife that reside all or part of their life cycle in or near the aquatic environment. Both aquatic and wildlife criteria were assessed and defined.

Niagara Relicensing – Niagara, NY

Client: URS

Joe monitored total dissolved gas and oxygen downstream of the Niagara River Power plant operated by NYSEG. The monitoring was required for the re-licensing of the plant. High TDG can harm fish such as trout that use the Niagara River.

ERA - West Eugene Wetlands – OR

Client: The Nature Conservancy

Joe managed and prepared a report on the evaluation of potential thallium risks for aquatic life and wildlife. Wildlife are potentially exposed through food and water. Aquatic life were exposed in proposed ponds.

Airport Division: NPDES Support – SeaTac, WA

Client: R.W. Beck

Joe supported the evaluation of the airport expansion study by evaluating effects of total suspended solids (TSS) and turbidity on aquatic life. Turbidity and TSS were evaluated, because construction activities were a source of suspended solids to nearby stream systems.

Condit Turbidity Consulting – Condit Dam, OR

Client: PacifiCorp

Joe provided technical support in the evaluation of total suspended solids. He evaluated background total suspended solids levels in Washington State rivers to compare to modeled levels in river.

Development of Cyanide Site-Specific Objectives – Corvallis, OR

Client: HydroQual, Inc.

Joe supported HydroQual in the technical assessment of cyanides potential effect on aquatic life in various Los Angeles County streams. He identified the streams that both had endangered and threatened species and also had potential cyanide sources.

Site-Specific Water Quality Criteria – Globe, AZ

Client: Hydro Geo Chem, Inc.

Joe managed the studies on the development of site-specific water quality guidelines for aluminum, cobalt, and manganese for a mine-affected stream. Metal-rich acid mine drainage was the source of chemical constituents to the stream. U.S. EPA guidelines were followed during criteria development. The criteria development included extensive literature searches and report evaluations.

Wetland Treatability Study – Globe, AZ

Client: Hydro Geo Chem, Inc.

Joe managed feasibility studies on the application of wetlands and chemical treatment to remove manganese and other metals from surface water at the site. Metal-rich acid mine drainage is the source of chemical constituents in this evaluation. Studies included an evaluation of a passive wetland treatment system, a chemical/physical treatment system, and a combination of the two systems.

Ecological Risk Assessment – Miami, AZ

Client: AGRA Earth & Environmental

Joe managed the evaluation of ecological risk and natural resource damage due to a tailings spill into a stream at the site. Metals in the tailing residue is the source of chemical constituents in this evaluation. Studies included development of site-specific guidelines for cleanup of residues in the stream, defining the damage to the stream biota, and a bioassessment of the stream.

Biological Monitoring – Rumford, ME

Client: Boise Cascade Corporation

Joe developed, directed, and supervised a fish, sediment and water sampling plan for the Androscoggin River near Rumford, Maine. The sampling plan included the collection and analysis of fish for body tissue levels of mercury and dioxin. The outcome of the sampling plan was to analyze the possible impact to human and ecological health due to past and present operations at a pulp and paper mill.

Aquatic Ecological Risk Assessment Methodologies

Client: The Cadmus Group

Joe provided technical support in the preparation of a guidance document for the Water Environment Research Foundation that describes aquatic ecological risk assessment methodologies. These methodologies were presented as a tiered approach: screening level risk assessment, detailed risk assessment with extant data, and detailed risk assessment with new data. Case studies were used to evaluate the methodologies.

Principal Published Works

- Volosin, J.S. and R.D. Cardwell. 2002. Relationships between aquatic hazard quotients and total risk estimates: What is the Significance of a hazard quotient? Human and Ecological Risk Assessment, 8:355-368.
- Parkhurst, B.R., W. Warren-Hicks, R.D. Cardwell, J. Volosin, T. Etchison, J.B. Butcher and S.M. Covington. 1995. Risk managing methods: Aquatic ecological risk assessment aids decision making. Water Environment and Technology; 7:39-43.
- R.D. Cardwell, Parkhurst, B.R., W. Warren-Hicks, and J.S. Volosin. 1993. Aquatic ecological risk. Water Environment and Technology; 5:47-51.

Conference Papers and Posters

- Volosin, J.S. and R.D. Cardwell. "Total suspended solids - Aquatic risks on a cross-section of natural waters." Presented at the 20th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Salt Lake City, UT; November 16-20 2002.
- Volosin, J.S. and R.D. Cardwell. Relationships between aquatic hazard quotients and total risk estimates: What is the Significance of a hazard quotient? Presented at the 20th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Nashville, TN; November 12-16 2000.
- Volosin, J.S. and R. D. Cardwell. "Use of macroinvertebrates for biocriteria evaluation of Eagle River: Selection of biotic indices. Presented at the 18th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Charlotte, NC; November 15-19 1998.
- Volosin, J.S., N. Merrill, K. V. Brix, and R. D. Cardwell. "Wet testing involving test waters with high total dissolved solids". Presented at the 18th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Charlotte, NC; November 15-19 1998.
- Volosin J.S. and R.D. Cardwell. "Use of macroinvertebrate biological integrity parameters for biocriteria: Comparison of streams in Montana and Colorado." Presented at the 16th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Vancouver, BC, Canada; November 5-8 1995.
- Volosin J.S. and R.D. Cardwell. "Use of macroinvertebrates for biocriteria evaluation of Eagle River: Comparison of RBP and Statistical Approaches to Evaluate Parameters." Presented at the 15th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Denver, CO; October 30 - November 3 1994.
- Volosin J.S. and R.D. Cardwell. "Ecological risk estimates for aquatic life in streams adjacent to copper/silver mining activity in Montana: Validation with A Macroinvertebrate Monitoring Program." Presented at the 15th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Denver, CO; October 30 - November 3 1994.
- Volosin J.S. and R.D. Cardwell. "A wildlife risk assessment methodology applied to acid mine drainage." Presented at the 14th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Houston, TX; November 14-18 1993.

- Volosin J.S. and R.D. Cardwell. "An aquatic ecological risk assessment methodology applied to acid mine drainage." Presented at the 14th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Houston, TX; November 14-18 1993.
- Volosin J.S. and R.D. Cardwell. "Risk assessment of water quality cleanup goals for a river affected by acid mine drainage." Presented at the 13th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Cincinnati, OH; November 9-12 1992.
- Volosin J.S., M.S. Brancato, and R.D. Cardwell. "Macroinvertebrate and water quality monitoring program for streams adjacent to copper/silver mining activity in Montana." Presented at the 12th Annual Meeting of the Society of Environmental Toxicologists and Chemists in Seattle, WA; November 3-7 1991.
- Richardson, N.A., J.S. Volosin, and R.A. McGrath. "The Application of Joint Probability Analysis for Assessing Aquatic Ecological Risk." Presented at Oceans '89 Conference in Seattle, WA; September 18-21, 1989.
- Kari, F.W., S.M. Driscoll, A. Abu-Shakra, S.C. Strom, W.L. Jenkins, J.S. Volosin, K.M. Rudo, and R. Langenbach. 1990. Comparative Metabolism and Genotoxicity of the Structurally Similar Nitrophenylenediamine Dyes, HC Blue 1 and HC Blue 2, in Mouse Hepatocytes. Cell Biology and Toxicology: 6:139-155.

Carrie A. Smith

Position in Company:	Toxicologist
Specialization:	Environmental Toxicology and Risk Assessment
Nationality:	American
Education and Professional Status:	BSc, Biological Sciences, 1999 Environmental Studies Certificate, 1999 MSc, Zoology – Environmental Toxicology and Statistics, 2003
Membership of Professional Bodies:	<ul style="list-style-type: none">• Society of Environmental Toxicology and Chemistry• Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry
Key Areas of Expertise:	<ul style="list-style-type: none">• Aquatic and terrestrial toxicology and ecological risk assessment• Data management and analysis• Geographic Information Systems (GIS)• Toxicological, toxicokinetic, and abiotic fate and transport modeling
Language Capabilities:	English

Key Professional Experience

Update of Nickel IUCLID Dossier – Albany, OR

Client: Nickel Producers Environmental Research Association

Carrie assisted the Nickel Producers Environmental Research Association (NiPERA) with updating their existing ecological and mammalian/human health IUCLID dossiers for several nickel compounds (Ni metal, Ni chloride, Ni sulfate, Ni nitrate, Ni acetate, Ni carbonate). In particular, she conducted detailed literature searches and reviews of new study information since the IUCLID dossiers were last updated in 2002 and reviewed these literature studies against Klimisch criteria. Her work was focused on the effects of nickel compounds in soils and in freshwater and marine environments. Updated ecological and mammalian/human health dossiers will be used to support the registration of these compounds under the European REACH initiative.

Development of European Soil Metalloregions – Corvallis, OR

Client: International Copper Association

Carrie compiled and maintained a large GIS of European soil bioavailability parameters. She conducted geostatistical kriging analyses to determine the spatial distribution of parameters important in controlling the bioavailability of metals in European soils. She predicted the spatial distribution of copper toxicity in European soils by combining the terrestrial-Biotic Ligand Model and kriging analyses.

Literature Evaluation of Manganese in European Soils – Albany, OR

Client: International Manganese Institute

Carrie evaluated the extant data for manganese concentrations in soils to determine the potential for developing a Predicted Environmental Concentration (PEC) for the European Union (EU). Carrie is now in the process of evaluating these data to derive a soil PEC for use in EU manganese risk assessments.

PFTI Environmental Risk Assessment – Papua, New Guinea

Client: PT Freeport Indonesia

Carrie both managed this project and served on the project team to analyze and report on nearly 15 years of physical, chemical, and biological environmental monitoring data for the PT Freeport Indonesia copper and gold mine for its associated ecological, wildlife and human health risk assessments.

Lead Ambient Air Quality Criteria Document – Albany, OR

Client: US EPA

Carrie conducted statistical analyses and wrote a chapter on the spatial distribution of ambient and natural lead concentrations in surface water, sediment, and tissue (using the United States Geological Survey [USGS] National Water-Quality Assessment [NAWQA] Program database) for the USEPA Lead Air AWQC document.

UCR (Upper Columbia River) RI/FS – WA

Client: Teck Cominco

Carrie compiled a database of all toxicity information associated with the Upper Columbia River/Lake Roosevelt. She prepared presentation maps showing the spatial distribution of the following parameters along the Upper Columbia River/Lake Roosevelt: basins, bathymetry, heavy metals, heavy metal Ambient Water Quality Criteria (AWQC) exceedances, sediment sampling sites. Carrie also served as a technical editor/reviewer for several sections of the RI/FS Programmatic Work Plan.

Water Quality Criteria Kriging – Albany, OR

Client: Copper Development Association

Carrie conducted geostatistical kriging analyses and prepared maps depicting the spatial distribution of site-specific, chronic water quality criteria for copper in the Chesapeake Bay.

US EPA R-10 Architect and Engineering Services – Portland, OR

Client: US EPA

Carrie provided GIS support, conducted dietary risk and biota-sediment accumulation factor (BSAF) analyses for several Lower Willamette River species, and contributed to the development of a hybrid hydrodynamic/sedimentation, contaminant fate and transport, food web model for the site. She also provided technical support on many aspects of the screening level and baseline environmental risk assessments.

Ecological Risk Assessments, Magnesium Processing Facility – UT

Client: US Magnesium

Carrie provided technical support for risk calculations and GIS support (spatial interpolation analyses) for presentation of the exposure assessment component of this ecological risk assessment.

Ammonia Water Effect Ratio Study and AWWQRP Special Studies – Albany, OR

Client: Pima County Department of Wastewater

Carrie coordinated and oversaw several laboratory toxicity tests (at both PERL and a subconsultant laboratory) to evaluate the influence of sodium and alkalinity vs. hardness in controlling the acute toxicity of ammonia to freshwater fish and invertebrate species. Carrie also managed the production of the comprehensive study reports and authored a manuscript on this research.

Valdez NRDA – Prince William Sound, AK and Corvallis, OR

Client: Exxon Mobil

Carrie conducted several toxicity tests to determine the effect of water quality parameters and solar radiation on the acute photo-enhanced toxicity of fluoranthene and Prince William Sound water to larval Pacific herring, juvenile Pacific herring, and larval fathead minnow. She compiled a literature review on the factors affecting light penetration in sea water.

Principal Published Works

- Van Genderen E, Gensemer R, Smith C, Santore R, Ryan A. 2007. Evaluation of the biotic ligand model relative to other site-specific criteria derivation methods for copper in surface waters with elevated hardness. *Aquatic Toxicology*, 84: 279 – 291.

Conference Papers and Posters

- Smith CA, Gensemer R, Van Genderen EJ, Ramage K, Curley E, Meyerhoff R. Influence of elevated hardness on ammonia toxicity to fish and aquatic invertebrates. Presented at the 2007 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Milwaukee, WI. (Poster Presentation)
- Smith CA, Gensemer R, Van Genderen EJ, Ramage K, Curley E, Meyerhoff R. Influence of elevated hardness on ammonia toxicity to fish and aquatic invertebrates. Presented at the 2006 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, Canada. (Poster Presentation)
- Smith C, Van Genderen E, Stubblefield W, Brock T, Welton R. Preliminary investigations into the aquatic toxicity of cobalt to freshwater biota. Presented at the 2006 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, Canada. (Poster Presentation)
- Van Genderen E, Gensemer R, Smith C, Santore R, Ryan A, Ramage K, Curley E, Meyerhoff R. Evaluation of copper criteria in very hard water. Presented at the 2006 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Montreal, Canada. (Platform Presentation)
- Smith C, Van Genderen E, Stubblefield W, Brock T, Welton R. Preliminary investigations into the aquatic toxicity of cobalt to freshwater biota. Presented at the 2006 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Poster Presentation)

- Cardwell AS, Smith CA, Gensemer R, Van Genderen EJ, Ramage K, Curley E, Meyerhoff R. Influence of elevated hardness on ammonia toxicity to fish and aquatic invertebrates. Presented at the 2006 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Poster Presentation)
- Edgington AJ, Van Genderen EJ, Gensemer R, Smith C, Santore R, Ryan A, Ramage K, Curley E, Meyerhoff R. Evaluation of copper criteria in very hard water. Presented at the 2006 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Platform Presentation)
- Van Genderen E, Gensemer R, Smith C, Santore R, Ryan A, Ramage K, Curley E, Meyerhoff R. Validation of biotic ligand model performance in extremely hard surface waters of the arid southwest. Presented at the 2006 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Platform Presentation)
- Van Genderen E, Smith C, Stubblefield W, Brock T, Welton R. Preliminary investigations into the aquatic toxicity of cobalt to freshwater biota. Presented at the 2006 Annual Europe Meeting of the Society of Environmental Toxicology and Chemistry, Porto, Portugal (Poster Presentation)
- Smith C, Stubblefield W, Fairbrother A, Allen H.E., Schoeters I, Dwyer R. Distribution of soil bioavailability parameters throughout Europe and development of t-BLM based metalloregions. Presented at the 2005 Annual Europe Meeting of the Society of Environmental Toxicology and Chemistry, Lille, France. (Platform Presentation)
- Stubblefield W, Oris J, Smith C, Maki A. Relationship of water quality characteristics, solar radiation, and photoinduced toxicity of PAHs in Prince William Sound, Alaska, USA. Presented at the 2005 Annual Europe Meeting of the Society of Environmental Toxicology and Chemistry, Lille, France. (Poster Presentation)
- Smith C, Stubblefield W, Clark J, Fairbrother A, Allen H, Schoeters I, Dwyer R. Distribution of soil bioavailability parameters throughout Europe and development of metalloregions. Presented at the 2004 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Poster Presentation)
- Oris JT, Stubblefield WA, Smith CA, Maki A. Relationship of water quality characteristics, solar radiation, and photoenhanced toxicity of PAHs in Prince William Sound, Alaska. Presented at the 2004 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Portland, OR. (Platform Presentation)
- Smith C, Stubblefield W, Clark J, Fairbrother Schoeters I, Dwyer R. Distribution of soil bioavailability parameters in Europe. Presented at the 2003 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Portland, OR. (Platform Presentation)
- Oris JT, Smith CA, Hoffmann JL, Allen BC, Miller GC. Toxicity and phototoxicity of high recreational use waters in alpine lakes of the Sierra Nevada. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Invited Platform Presentation)

- Oris JT, Stubblefield WA, Smith CA, Maki AW. Solar radiation and water attenuation coefficients in Prince William Sound, Alaska. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Invited Platform Presentation)
- McClain JS, Roberts AP, Mehling MG, Smith CA, Oris JT. A multi-level index of ecological integrity and biological impact for alpine lakes of the Sierra Nevada. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Invited Platform Presentation)
- Roberts AP, McClain JS, Steffen KL, Hoffmann JL, Smith CA, Oris JT. Application of molecular biomarkers to water quality monitoring in the Sierra Nevada. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Poster Presentation)
- Smith CA, Wright SE, Oris JT. Development, evaluation and application of a physiologically-based toxicokinetic (PBTk) model for fluoranthene in rainbow trout. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Poster Presentation)
- Roberts AP, McClain JS, Steffen KM, Hoffmann JL, Smith CA, Oris JT. Correlating inducible gene response in juvenile rainbow trout (*Oncorhynchus mykiss*) with motorized boat traffic in Sierra Nevada lakes. Presented at the 2003 Annual Meeting of the Ohio Valley Chapter of the Society of Environmental Toxicology and Chemistry, Cincinnati, OH. (Platform Presentation)
- McClain JS, Roberts AP, Smith CA, Oris JT. Correlating biological indicators of stress in Sierra Nevada lakes with ecological disturbance. Presented at the 2003 Annual Meeting of the Ohio Valley Chapter of the Society of Environmental Toxicology and Chemistry, Cincinnati, OH. (Platform Presentation)
- Smith CA, McClain JS, Mehling MG, Oris JT. Development of a multi-level index of ecological integrity for alpine lakes of the Sierra Nevada. Presented at the 2003 Annual Meeting of the Ohio Valley Chapter of the Society of Environmental Toxicology and Chemistry, Cincinnati, OH. (Poster)
- McClain JS, Roberts AP, Smith CA, Guttman SI, Oris JT. A multivariate and GIS analysis of molecular and ecosystem indicators of stress in Sierra Nevada lakes. Presented at the 2003 Annual Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, UT. (Invited Platform Presentation)
- Smith CA, McClain JS, Mehling MG, Oris JT. Development of a multi-level index of ecological integrity for alpine lakes of the Sierra Nevada. Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Salt Lake City, UT. (Poster)
- McClain JS, Roberts A, Smith CA, Allen B, Oris JT. Correlating biological indicators of stress in Sierra Nevada lakes with ecological disturbance. Presented at the 2002 Sierra Science Symposium, Lake Tahoe, CA. (Poster)
- Smith CA and Svendsen G. Large rodents. Presented at the 1998 Annual Meeting of the American Society of Mammologists. Blacksburg, VA. (Poster)

Jeff Wirtz

Position in Company:	Toxicologist
Specialization:	Environmental Toxicology and Risk Assessment
Nationality:	American
Education and Professional Status:	BA, Biology, 1995 BA, German, 1995 MSc, Land Resources, 2000
Membership of Professional Bodies:	<ul style="list-style-type: none">• Society of Environmental Toxicology and Chemistry• Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry• Society of Quality Assurance
Key Areas of Expertise:	<ul style="list-style-type: none">• Aquatic and terrestrial toxicology and ecological risk assessment• Data management and analysis• Quality assurance / Good Laboratory Practice (GLP) standards
Language Capabilities:	English

Key Professional Experience

Update of Nickel IUCLID Dossiers – NC

Client: Nickel Producers Environmental Research Association

Assisted the Nickel Producers Environmental Research Association (NiPERA) with updating their existing IUCLID dossiers for several nickel compounds (Ni metal, Ni chloride, Ni sulfate, Ni nitrate, Ni acetate, and Ni carbonate). In particular, conducted detailed literature searches and reviews of new study information since the IUCLID dossiers were last updated in 2002. Helped review these new literature studies against Klimisch criteria and scored them accordingly. Work was focused on the effects of nickel compounds in soils and in freshwater and marine environments. Currently, the project manager on the next phase of this update process (i.e., updating the human health section of the same dossiers). Once completed, the final dossiers will be used to support the registration of these compounds under the European REACH initiative.

UCR (Upper Columbia River) RI/FS – WA

Client: Teck Cominco

Summarized historical sediment quality data from the Upper Columbia River (UCR) and prepared write-up of findings as part of the workplan for the Remedial Investigation/Feasibility Study (RI/FS). One of two assistant project managers on the project for Parametrix and is responsible for day-to-day management of the project, including document retention compliance. Other duties include providing technical support to the screening-level and baseline ecological risk assessments, sampling and analysis plans, and other technical documents.

PTFI Environmental Risk Assessment – Papua, New Guinea

Client: PT Freeport Indonesia

Served on the project team to analyze and report on nearly 15 years of physical, chemical, and biological environmental monitoring data for the PT Freeport Indonesia copper and gold mine for its associated ecological, wildlife, and human health risk assessments.

Endangered Species Risk Assessment for Synthetic Pyrethroids – MA

Client: Pyrethroid Working Group

Developed data evaluation criteria checklist to rate the quality of aquatic toxicity test reports. Reviewed and evaluated all available aquatic toxicity test reports as first step of an endangered species risk assessment for synthetic pyrethroids. Compiled all reviewed data into a spreadsheet database and determined the most reliable toxicity data for each species.

ARAMS Terrestrial Toxicity Database – MD

Client: U.S. Army Center for Health Promotion and Preventative Medicine

Compiled all high quality TRVs for terrestrial wildlife and soil benchmarks for plants and soil invertebrates from a wide range of jurisdictions. Ranked each applicable TRV/benchmark by quantitative data quality criteria and entered all data into Excel spreadsheets for input into an MSAccess® database. Prepared a background document and a user's guide for the database to accompany the final product to the client. The final product was an MSAccess® database that provides a selection of ecologically-relevant TRVs for wildlife and soil benchmarks for plants and soil invertebrates.

Channel Deepening Reconsultation – Lower Columbia River, OR & WA

Client: Port of Portland

Identified and acquired all applicable sediment sampling data that included chemical analyses for the lower Columbia River. Analyzed and interpreted these data regarding their applicability to the Columbia River Channel Deepening Project proposed by the Army Corps of Engineers. Aided in the probabilistic risk assessment that used these data to estimate risks that the proposed channel deepening may pose to Endangered Species Act-listed salmonids.

Reservoir Screening Level Risk Assessment – AZ

Confidential Client

Prepared a site description that included the nature of the reservoir ecosystem. Identified which species in the area were receptors of concern (ROCs) based upon site visits and available reference information. Derived the most appropriate TRVs from the literature for the contaminants of concern for the ROCs identified. Used fish tissue data collected onsite to calculate Hazard Quotients for the ROCs to assess the risk to each that consumption of fish from the reservoir might pose. Prepared a draft report of the wildlife risk assessment and uncertainty analysis to be included in the final project report.

EPA Mercury Update – DC

Client: USEPA

Authored a background paper that assessed risk of mercury to aquatic ecosystems. Summarized the exposure pathway from coal-fired power plants and identified ecological regions of greatest risk based upon information found in the Mercury Study Report to Congress, the USEPA Office of Research and Development Mercury Research Strategy, and other pertinent documents. Also identified the

magnitude of reduced risk to at-risk ecological regions if mercury from coal-fired power plants is reduced or eliminated. Paper served as part of the technical background for a white paper NCEA submitted to the USEPA Office of Air for assessing risk of mercury to ecosystems. The NCEA white paper will be an informational document in the Air Office regulatory determination of control of emissions from coal-fired power plants.

Principal Published Works

Phipps T, Tank SL, Wirtz J, Brewer L, Coyner A, Ortego LS, Fairbrother A. 2002. Essentiality of nickel and homeostatic mechanisms for its regulation in terrestrial organisms. *Environmental Reviews*, 10:209-261.

Conference Papers and Posters

Wirtz J, Stubblefield W. Manganese Water/Sediment/Soil Quality Criteria Database: Review of Existing Data and Recommendations. Presented at the 2006 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Montréal, Canada. (Poster Presentation)

Wirtz J, Stubblefield W, De Schampelaere K, Naddy R, Ortego L, Schlekot C. Modifying Effects of Water Quality Parameters on the Acute and Chronic Toxicity of Nickel to *Ceriodaphnia dubia*. Presented at the 2004 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Portland, OR. (Poster Presentation)

Wirtz JR, Geis SW, Sonzogni, WC. The Nature and Degree of the Toxicity of High Molecular Weight, Anionic Polyacrylamides (PAMs). Presented at the 2003 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry, Austin, TX. (Poster Presentation)

Cardwell RD, Wirtz, JR. A preliminary assessment of potential risks posed by PAHs, PCBs, and DDT to Juvenile Salmonids: Lower Columbia River. Presented at the 2002 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Portland, OR. (Platform Presentation)

Wirtz JR, Allen L, Fairbrother A, Johnson MS. Searchable database of toxicity reference values and soil benchmarks for terrestrial organisms. Presented at the 2001 Annual North America Meeting of the Society of Environmental Toxicology and Chemistry in Baltimore, MD. (Poster Presentation)

Allison S. Cardwell

Position in Company:	Laboratory Supervisor
Specialization:	Environmental Toxicology
Nationality:	American
Education and Professional Status:	BSc, Fisheries Biology, 1998
Membership of Professional Bodies:	<ul style="list-style-type: none">• Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry
Key Areas of Expertise:	<ul style="list-style-type: none">• Aquatic and sediment toxicology• Development of laboratory testing protocols• Data management and statistical analysis• Good Laboratory Practices (GLP) testing
Language Capabilities:	English

Key Professional Experience

Update of Nickel IUCLID Dossier – Albany, OR

Client: Nickel Producers Environmental Research Association

Allison assisted the Nickel Producers Environmental Research Association (NiPERA) with updating their existing ecological and mammalian/human health IUCLID dossiers for several nickel compounds (Ni metal, Ni chloride, Ni sulfate, Ni nitrate, Ni acetate, Ni carbonate). Her work was focused on the effects of nickel compounds in soils and in freshwater and marine environments. Updated ecological and mammalian/human health dossiers will be used to support the registration of these compounds under the European REACH initiative.

Validation of Nickel BLM Predictions for Selected Non-standard Organisms – Albany, OR

Client: Nickel Producers Environmental Research Association

Allison supervised and conducted laboratory studies which involved investigating whether biotic ligand model's (BLM) appropriately represented all organism classes/trophic levels that constitute the entire species sensitivity distribution. This work involved the development and validation of nickel BLM for purposes of developing site-specific regulatory frameworks.

Evaluation of the Aquatic Toxicity of Molybdenum and Derivation of Water Quality Criteria – Albany, OR

Client: International Molybdenum Association

Allison conducted toxicity tests to determine the chronic toxicity of molybdenum to freshwater aquatic organisms in support of future revisions to the Ambient Water Quality Criteria (AWQC; USEPA) for molybdenum. These studies involved early life stage testing to determine toxicity through different life stages of fish.

Evaluation of the Toxicity of Cobalt to Aquatic Organisms and Derivation of Water Quality Criteria – Albany, OR

Client: Cobalt Development Institute

Allison oversaw and conducted laboratory studies to evaluate the toxicity of cobalt to aquatic organisms in order to provide data suitable for the derivation of an Ambient Water Quality Criteria (AWQC; USEPA) and Predicted No Effect Concentration (PNEC; European Union). Her primary roles included data collection and analysis, statistical analysis and drafting reports.

Roosevelt Lake – Albany, OR

Client: Teck Cominco Metals

Allison conducted laboratory studies investigating whether slag-containing sediments pose an unacceptable risk to invertebrates. These studies involved consecutive years of toxicity tests following design of a special laboratory flow-through system.

Ammonia Water Effect Ratio Study and AWWQRP Special Studies – Albany, OR

Client: Pima County Department of Wastewater

Allison conducted several laboratory toxicity tests to determine the influence of pH at high water hardness on the toxicity of ammonia to various aquatic organisms. The study primarily consisted of tests which simulated a range of water quality parameters found throughout the arid western United States. Allison also aided in data analysis and the production of the comprehensive study reports.

Whole Effluent Toxicity Testing for NPDES Compliance Purposes

Various Clients

Allison directs standard acute and chronic toxicity tests according to EPA, ASTM, or OECD protocols to satisfy compliance testing requirements. Her work includes conducting Toxicity Identification/Reduction Evaluations (TIE) on complex effluents including custom designs for unique applications.

Conference Papers and Posters

Cardwell AS, Smith CA, Gensemer R, Van Genderen EJ, Ramage K, Curley E, Meyethoff R. Influence of elevated hardness on ammonia toxicity to fish and aquatic invertebrates. Presented at the 2006 Annual Meeting of the Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry, Port Townsend, WA. (Poster Presentation)

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